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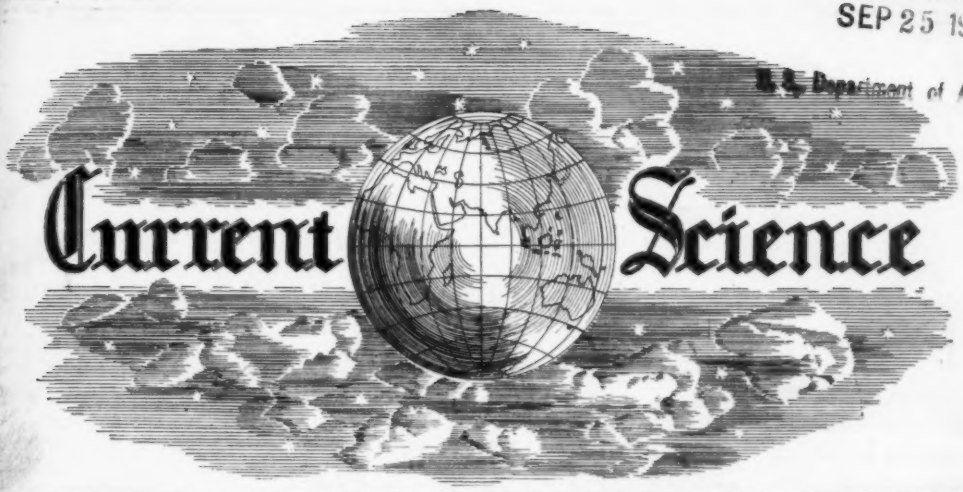

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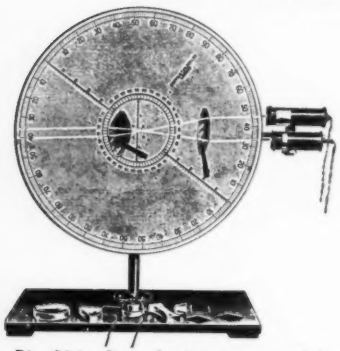

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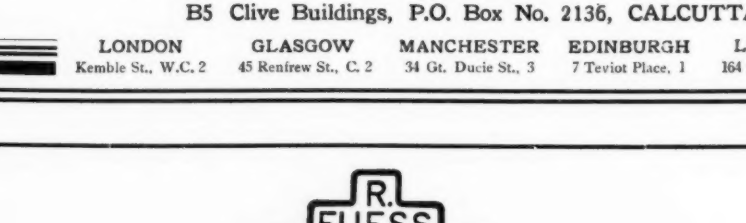

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The Problem of Malnutrition in India.

THE fact that millions—perhaps the majority—of the people of India suffer from various degrees of malnutrition seems beyond dispute. It is true that more precise data on this question are required—data which can be collected only by dietary surveys, and the systematic physical examination of sections of the population to reveal the incidence of states of malnutrition and deficiency diseases. But sufficient information already exists to prove that malnutrition is widespread. If the diets of the majority of the population, particularly of the poorer classes, are compared, even in a rough qualitative way, with the dietary standards put forward by modern physiologists, it at once becomes apparent that the former fall short of adequacy; in general, they are deficient in the more valuable proteins, and in certain vitamins and mineral salts. Again, food deficiency diseases—beri-beri, certain forms of anæmia, epidemic dropsy, xerophthalmia, etc.—are common throughout most of India. The poor physique and lack of resistance to infection shown by the majority of the population in many parts of the country also suggest that the average Indian diet is a defective one.

It should be realised that this state of affairs is not peculiar to India; that, in fact, the same problem exists in most countries of the world. Outside Western and Central Europe, North America, Australia and New Zealand, and perhaps a few other fortunate countries, the diet of the mass of the population is not very different in quality from that of the poorer classes in India. Thirty or forty years ago, malnutrition and certain food deficiency diseases—*e.g.*, rickets—were very common in England; it is only gradually that the dietary level of the masses is being raised even in the most prosperous countries. To-day China presents a problem of malnutrition which is as formidable as that of India, and there is evidence that other Eastern countries, such as Java, Malaya, and Japan, are in a scarcely more favourable position. The question of malnutrition in South America has been little studied as yet, but quite recently the authorities of one South American country very

remote from India—Chile—have reached the conclusion that dietary deficiency is one of the main causes of ill-health and disease in that country, and are taking steps to investigate and remedy the situation. It may well be that, for a number of reasons connected with religion and climate, the problem of dietary deficiency in India is more difficult of attack than elsewhere, but the difference is one of degree, not of kind. While economists talk of over-production of foodstuffs, the greater part of the world's population would be the better for more food of superior quality to eat.

As regards India itself, the subject of nutrition may conveniently be considered under two heads: research, and the practical application of modern knowledge. More precise data about the dietary habits of the people in different parts of the country are required; these can be obtained only by laborious surveys. In conjunction with such surveys, systematic physical examinations of selected groups should be carried out; apart from general impressions, we have little exact information about the prevalence of states of malnutrition and deficiency disease among urban and rural populations. It would be useful (and simple) to collect in schools data about average height and weight, for each age group, in different races, classes, etc., throughout the various provinces; English and American growth standards are not applicable to India. There are wide gaps in our knowledge of the nutritive values of Indian foodstuffs, particularly as regards vitamins, and mineral salts; steps are already being taken to fill these gaps. Quite apart from such obvious and necessary investigations, there remains a great deal of original clinical and laboratory research to be done on food deficiency disease. In all probability, there are food deficiency diseases in India which have never been observed or described, and even those diseases which are familiar text-book entities might repay further clinical, pathological and epidemiological study.

Certain statistical investigations concerning food supply in relation to population would help to clarify the situation. First a dietary standard reasonably capable of fulfilling the needs of human beings should be chosen, and this diet translated into terms of foodstuffs which can be produced or made easily available in India. Secondly, the food requirements of the population in terms of this adequate diet can be calculated, and a comparison drawn between the national requirements so defined and existing agricultural production and food imports. The fact would probably emerge that existing food production and import fall far short of the point at which such a diet could be supplied. Lastly, the improvements and changes on agriculture and imports necessary to attain this end can be stated in exact figures and subjected to careful analyses. A series of calculations of this nature would provide a solid basis for agricultural (and even fiscal) policy. The resulting figures might not, indeed, be too hopeful; they might clearly show that, in the absence of potentialities for great increase in food production, or of increase in national wealth allowing for food importation on a large scale, there must be a growing disproportion between available food supply and the dietary requirements of an expanding population.

A broad survey of the type outlined may be impossible at the moment owing to the lack of sufficiently accurate data about food values, crop production, livestock, etc. But there is no reason why such information could not be obtained. Bowley and Robertson, in their recent report,[1] have described the defects of existing statistical services and made various suggestions for their reorganisation. Improvement in statistical information would help nutrition research workers to grasp the problem of malnutrition in India as a whole.

Let us turn to the question of practical application, to what may be termed public health nutrition work. Sir Robert McCarrison has repeatedly emphasised the fact that knowledge in this field has already far out-run any efforts towards making use of that knowledge for the benefit of the people of India. Difficulties are enormous. While poverty is the main obstacle, ignorance and prejudice, by no means confined (in India as elsewhere) to the classes which are too poor to have much choice in the matter of food, must play a great part in producing malnutrition. Again, public health nutrition work in India can only develop *pari passu* with public health work of other kinds. But steps could be taken to ensure that nutrition work is given a prominent position in existing public health programmes, and that as time goes on it should receive increasing attention.

[1] A Scheme for an Economic Census of India. New Delhi, 1934.

For this purpose it is essential that emphasis should be laid on nutrition in the training of public health workers of all kinds, including medical officers of health, nurses, health visitors, etc. In some Western countries much practical nutrition work is carried out through the medium of maternity and child welfare centres, health visitors, and the school medical services. As such activities develop in India, opportunities will arise for improving diet by educational and other means.

The question of attaching nutrition specialists to public health departments might receive consideration. Each provincial department might perhaps employ an official with an extensive knowledge of the subject whose duties would be to prepare educational material, to assist in maternity and child welfare work and work in schools, to lecture to medical students, nurses, and subordinate public health officials, to regulate diet in public and residential institutions, etc. All large public health departments in U. S. A. have workers of this kind attached to them. It might be difficult to find men or women qualified to undertake duties of this nature at present in India, but in future provision could be made for their training by various means.

Elementary instruction about diet and food values might be given to the higher grades in the schools, both public and private. The interest taken in McCarrison's book *Food*, and the considerable use that has been made of it in schools, suggest a willingness on the part of school teachers to add this subject to the curriculum. But teachers themselves must first be taught its importance, and a useful line of attack would be through teachers' training colleges. With regard to the education of the public, something might be accomplished by means of suitable press articles, wireless talks, etc. There seems to be an awakening interest in nutrition throughout the country, and the literate classes might respond to intelligently prepared propaganda.

The problem of malnutrition in the village might be approached by selecting small "demonstration" rural areas for intensive work. Data about dietary habits could be collected by careful surveys involving a number of families, and subsequently correlated with the "state of nutrition" of the population group concerned. The exact nature of the deficiencies in the diet would thus be made apparent. The next step would be to attempt to improve nutrition in the "demonstration" area by various means—education and propaganda, maternity and child welfare work, improvement in livestock and agricultural production, etc. The chief aim of a public health nutrition experiment of the type outlined would be to investigate the possibilities of improvement lying within the resources of the people themselves. Results obtained in small areas might have a general application throughout the country.

If the public health side of nutrition work is to develop in the right direction, it is essential that adequately equipped research institutions should exist to provide basic knowledge. Nutrition research is being actively carried on at Coonoor and elsewhere, but there is room for extension of existing institutions working in this field and for the creation of new ones. Sir Robert McCarrison, writing in *Current Science* in July 1932, suggested that "each Presidency or Province should have its own Institute for the study of Nutrition". The activities of the ideal nutrition research institute should include basic scientific research, systematic surveys of foodstuffs, study of cheap well-balanced diets within the means of the poorer classes, field and epidemiological investigations, and a good deal of propaganda and education work. It should have a department for training public health workers of various kinds.

Researches in animal husbandry, nutrition, agriculture, and human nutrition, and efforts to apply in practice the results of scientific research in these fields, are complementary and directed towards the same end. The greatest possible co-operation between those concerned in these activities is desirable.

W. R. AYKROYD.

Planned Prosperity for the Peasant.*

SIR GEORGE SCHUSTER was one of the few Finance Ministers of India who took a comprehensive view of Indian finance and studied it in its larger relation to Indian economic life. Hence his interest in Economic Planning and Economic Councils, which he sought to prepare by inviting to India, two experts to report on the collection of economic statistics in India. In the stimulating lecture he recently delivered before the Royal Society of Arts, Sir George believes, as all those must who have given the problem any serious attention unaffected by prepossessions of one kind or other,—that "the vast masses of the Indian population must be based on rural economy and no conceivable degree of industrialisation can alter this within any period that can be foreseen". It is, therefore, of vital importance to the prosperity of the country that Indian agriculture should take advantage of recent developments in mechanisation of agriculture. But the increasing product of agriculture that will follow must find a sale abroad, but sales abroad are only possible if India will buy industrial goods in return, and a serious obstacle arises in the form of India's own industrial ambitions. If India will not buy from abroad, she cannot sell abroad, and if she cannot sell, her rural population is doomed to continued poverty. The dilemma is resolved, and the interests of a prosperous agriculture with the growth of Indian industrialisation are reconciled by the argument that "there are certain more elaborate forms of industrial products for which the Indian market alone will not give an economic foundation for independent manufacture, and for which India will not, for a long time to come, have the necessary skilled labour and technique"; among such are "motor-cars, telephones, wireless machines, gramaphones, etc." The category exists, though the list may be questioned. India can proceed along her own industrial advance in the direction of production of cotton piece-goods, iron and steel manufactures, sugar, and so on. Thus Sir George Schuster rests Indian prosperity upon the tripod ot improved agriculture, increased industrialisation, and imports of goods that India cannot expect to produce for herself in the near future on anything like an economic basis.

People are too often inclined to judge a country's prosperity by reference to figures of production and trade alone, and are either indifferent to problems that affect the standard of the life of the poor or are openly impatient of proposals like Factory and Social Legislation that are calculated to transfer to the workers some share of the gains in production. Sir George is emphatic in his view that "there is a great need for policies which will increase the material wealth of India, but this will be valueless unless they also secure the proper distribution of that wealth, and the greatest need of all is to raise the standard of living of the masses of the people". The problem is how to bring about a higher standard of life, and "somehow or other to get the rural masses of India out of the rut of their present low standards". This can be done partly by Government action and partly, as Sir George Schuster says, by convincing "public opinion of the need and getting all those who have any influence in the villages—landlords, District Councils, Municipalities, Universities, etc.—to work upon it. Mass psychology needs to be moved in the matter."

In view of the recent repudiation of economic planning by the present Finance Minister, it is of much significance that Sir George Schuster reaffirms his faith in economic planning. He holds that "some foresight" is necessary "as to what is to be produced, and an intensive effort to maintain production and presentation for marketing at the highest level of efficiency, so as to produce the best quality at the cheapest price." He believes that "Governments and especially the Government of a country like India, must take thought and give the lead and impetus in these matters". The first duty of the Government, in the absence of "sufficient statistical records" and their interpretation and co-ordination, is to arrange for "a map of its own economic country", and for this purpose a Central Organisation of Economic Intelligence and Statistics must be created. If an intelligent public opinion is to be created, "knowledge must be disseminated". In the light of this emphatic reaffirmation of the need for a scientific and ordered basis of study of economic data for the development of the

* "Indian Economic Life: Past Trends and Future Prospects", by Sir George Schuster: Sir George Birdwood Memorial Lecture, Royal Society of Arts.

country, it is to be hoped that the Government of India will take early steps to give effect to the recommendations of the experts and arrange for an Economic Census of India at an early date, even if the Economic Advisory Organisation recommended by Sir Arthur Salter is to wait till the new Constitution is in operation.

The Baluchistan Earthquake of May 31, 1935.*

By W. D. West,
Geological Survey of India.

THE earthquake which occurred in Baluchistan on May 31st was remarkable in two respects. It was of high intensity at the epicentre, causing great mortality and much damage to property, yet it was felt over a comparatively small area, a little over 100,000 square miles. This is a rather characteristic feature of earthquakes in Baluchistan, and indicates that they must have a shallow focus. The epicentre, where the greatest damage was sustained, extended from the north-west of Quetta to half-way between Mastung and Kalat. Its position is shown on the accompanying map, together with the epicentres of the earthquakes of 1931 and 1909.

Since most of the inhabitants were asleep at the time of the earthquake, little information was forthcoming regarding the beginning of the shock. It so happened, however, that night operations were being carried out that night at a place about 4 miles to the north of Quetta, and it appears from the evidence of those taking part that about 5 to 10 seconds before the main shock started there was a preliminary tremor sufficiently strong to be recognised as an earthquake shock. The main shock came from the south and was accompanied by a noise like the roar of a train in a tunnel. The motion was described by the same observers as being like the action of a small boat in a choppy sea. People in Quetta itself generally described it as a sharp horizontal shake.

The shocks seem to have lasted nearly half a minute. During this time the whole of Quetta City, part of the Civil Lines, the Railway Quarters, the Police Lines and the R. A. F. Lines were laid in ruins. The northern and north-eastern part of Quetta, in which are situated the Cantonment and the Staff College, was much less affected; and although the city must have suffered a shock of almost intensity 10 on the Rossi-Forel Scale, at the Staff College, distant only 3½ miles from the city, the intensity was only 6. In fact, many people living in the Staff College area went back to bed after the earthquake, and were surprised the next morning when, on going towards the city to do their shopping, they found the whole place in ruins. This was almost certainly due to the varying nature of the ground, the area where destruction was greatest being situated on water-logged alluvium, while the Cantonment and the Staff College are situated on dry alluvium.

One striking feature of the earthquake, which caused many people to think that it had a volcanic origin, was the great quantity of dust which arose from the surrounding hills, and specially from Chiltan mountain, both at the time of the main shock and also on the afternoon of June 2nd, when a very severe aftershock occurred. Needless to say the "smoke," which was thought to have been seen ascending from Chiltan, was only dust caused by the collapse of thousands of tons of limestone as a result of the severe shaking which the mountain received.

Another feature of the earthquake which aroused much interest was a line of fissuring in the ground which extended on and off for over 70 miles, from the south side of Chiltan to near Kalat. In places along this line the alluvium was severely fissured, in other places the ground had subsided two or three feet on one side or the other, while elsewhere the ground had heaved up a foot or two. Careful examination of this area, however, showed that the fissuring was purely a surface phenomenon, coinciding with the line of greatest intensity of shock, and it was clear that it did not penetrate the solid rock beneath. Where this line of fissuring crossed the railway line from Quetta to Nushki, the rails were severely crumpled.

* Published with the permission of the Director, Geological Survey of India.

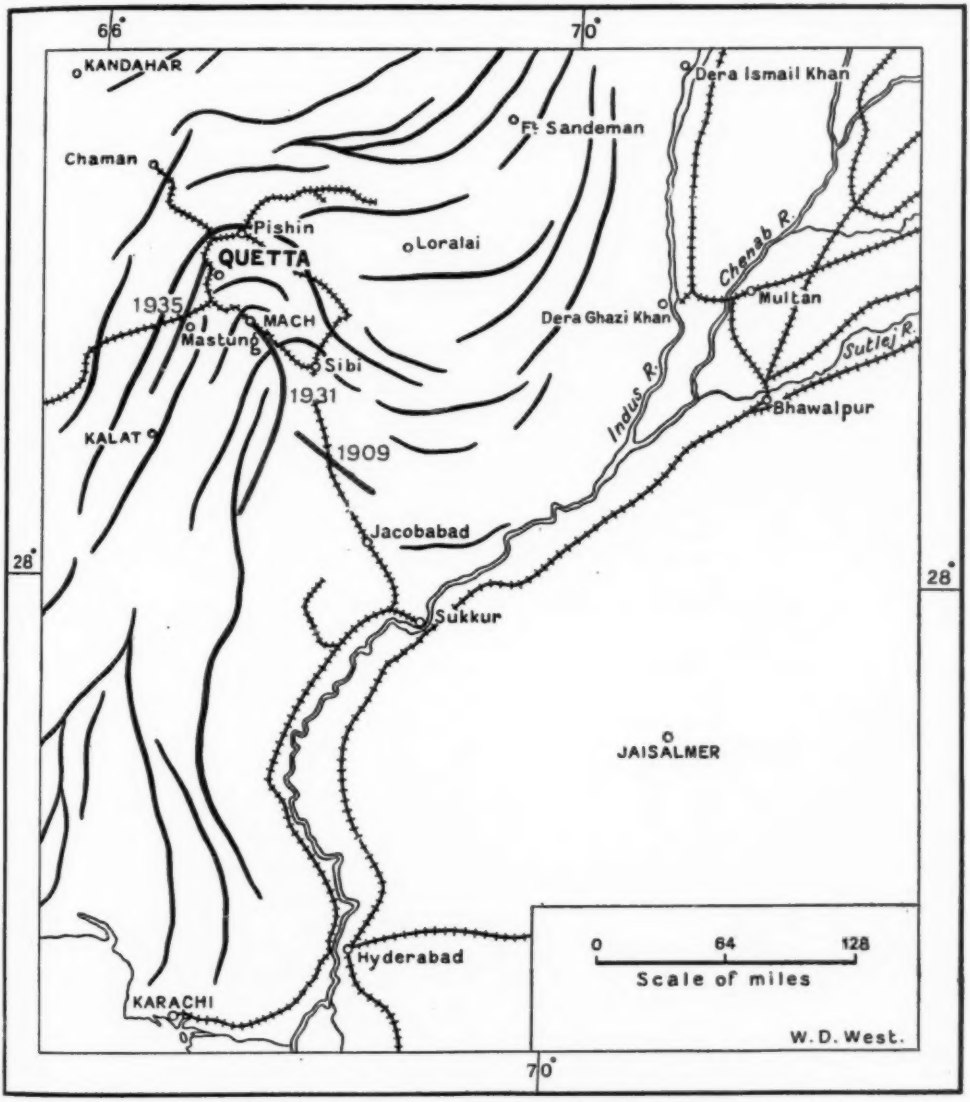
About 100 miles south of Quetta an old mud volcano burst into eruption at the time of the shock, and continued ejecting hot mud for about 9 hours. The term 'mud volcano' is really a misnomer, since it is generally accepted that these phenomena have no connection with true volcanic activity.

In discussing the origin of the earthquake, it is necessary to take into consideration the geological structure of Baluchistan. The general alignment of the mountains is shown very well on the accompanying map, and since the geology and geography are very closely related, in that the axes of the rock folds are parallel to the main mountain ranges, the map also gives an idea of the general geological structure of the country. These folds have been formed by a compression of the rocks in a N. W.—S. E. direction, so that, taking the area as a whole, the folds should be aligned in a N. E.—S. W. direction. This, however, is not the case, and instead the mountains are looped up

Fig. 1.
An earthquake-proof bungalow built by the North-Western Railway.

Fig. 2.
The Dak Bungalow, Quetta.

to the north-west between Jacobabad and Quetta. Now it is generally accepted that these folds have been formed by the movement of the old stable mass of Central Asia towards the stable mass of Peninsular India, resulting in the compression of the soft marine rocks in between to form the mountains. It is therefore suggested that this sharp deflection in the alignment has been caused by some underground obstacle



MAP OF BALUCHISTAN AND SIND, SHOWING THE ALIGNMENT OF THE MOUNTAINS AND THE EPICENTRES OF THE LAST THREE EARTHQUAKES.

which is obscured from view by the alluvium of the Indus valley, and which has prevented the free movement of the folds towards the south-east. The effect may be likened to the waves of the sea, when they are deflected in their course towards the shore by the obstruction of a breakwater. The waves flow freely on either side, but are held up by the break-water. Whether or not this hypothesis is correct, it is a fact that the geology around Quetta is more complicated than it is in any other part of Baluchistan, and the rocks have yielded here not only by folding but also by fracture. It is around this re-entrant angle that the greatest strain must occur, and it is here that one would expect most earthquakes to originate. In actual fact this is the case, and most of the severe earthquakes which have visited Baluchistan have been confined to an area within a radius of about 150 miles of Mastung.

In the case of the last three severe earthquakes which have visited Baluchistan, namely those of 1909, 1931 and 1935, the epicentres of which are shown on the map, no connection could be traced between the location of the epicentres and any known fault. It therefore seems clear that the earthquake, if it was due to movement along a fault, must have been connected with some fault which does not reach the surface of the ground.

The enormous death roll which occurred at Quetta is directly attributable to the very poor manner in which nearly all the buildings were constructed. Owing to the scanty rainfall in this part of India, it has been the practice in the past to use a mud mortar. Such a mortar has very little bonding power, and when an earthquake occurs, the very heavy lateral force to which the building is subjected simply causes the bricks to slide over one another, and the building collapses. In the case of the present earthquake a feature of great interest was provided by certain North-Western Railway bungalows which had been built since the 1931 earthquake and had been designed on earthquake-proof lines. Although surrounded by smashed buildings, they are without a single crack. The accompanying photographs show the completely ruined Dak bungalow in Lytton Road and one of the new earthquake-proof Railway bungalows situated on the other side of the road. It is difficult to imagine a more striking illustration of the efficacy of sound earthquake-proof construction, in which rigidity has been the main consideration. By making a building as rigid as possible, instead of the building falling apart during an earthquake, due to the different parts of the building behaving differently, it will move as a whole and so avoid being cracked. That these Railway bungalows did move as a whole was clearly shown by the fact that those who were living in them were so severely shaken that they were unable to stand up inside the bungalow during the earthquake, while heavy almirahs were also thrown down. These bungalows had been made rigid by bracing with vertical and horizontal iron rails, and had been constructed to withstand a horizontal acceleration of 3·2 feet per second per second. From this, however, it is not to be inferred that the acceleration of the earthquake motion was less than 3·2 feet per second per second, because in constructional work a considerable factor of safety is always allowed, which may be as much as 3 or 4.

It will be seen from the map that the centre of earthquake activity has gradually moved north-westwards since 1909. It is doubtful, however, if any conclusion regarding the location of the next earthquake can be inferred from this. Such knowledge as we have of previous earthquakes, in Baluchistan shows that they jump about from place to place in accordance with no apparent law. If, however, an earthquake be regarded as affording relief to the strains which have accumulated in the rocks, then it may be fairly safely predicted that the next earthquake, when it occurs, will not be located along the same line as the present one.

The Pre-Vindhyan Geology of Rajputana.

By A. M. Heron,
*Geological Survey of India.**

SINCE 1907 a geological survey of Rajputana and the States of Bombay which adjoin it to the south in Gujarat has been in progress. Its results have been presented from time to time in papers by the author and his colleagues Mr. C. S. Middlemiss, Dr. A. L. Coulson and Mr. B. C. Gupta, and several other publications are in preparation. As, however, it may be some time before the main description dealing with the work done in central Rajputana since the Great War can appear, it has been thought advisable to submit a brief sketch of the results obtained. A somewhat fuller account of this has appeared in the *Transactions of the National Institute of Sciences of India*, Vol. I, No. 2.

The rocks below the Vindhyans and the Malani volcanics have been arranged in four groups, separated by three erosion unconformities, all of which are in places clearly shown by basement conglomerates accompanied by other evidences of discordance, and are in addition well displayed in the mapping by the trend of the boundaries of the formations. The unconformity most distinctly seen, that at the base of the Delhi system, has been traced for something like five hundred miles along the edges of the synclinorium, which is almost exactly coincident with the limits of the Delhi system, for outside of it representatives of the Delhis are insignificant and somewhat uncertain. It appears to have been the successor to a geosyncline in which the Delhis were accumulated; on either side of it are found the older formations—the Raialo series, the Aravalli system and the pre-Aravalli gneisses.

The succession is shown in the annexed table.

In view of the presence in Rajputana of four distinct Precambrian and Archæan formations, separated by important unconformities each denoting a period of diastrophism and erosion, and of the immense thicknesses of strata involved, it is reasonable to infer that the Bundelkhand gneiss and the banded gneissic complex at the base of this long sequence are among the oldest rocks which occur anywhere upon the earth's surface. If the Vindhyans are also placed in the Precambrian, neglecting the doubtful evidence of obscure markings which are held by some palæontologists to be primitive Cambridge brachiopods and by others to be vegetable remains, the sequence is still further lengthened and the oldest rocks are pushed farther down in the Archæan.

Unfortunately we can say nothing definite regarding the relationship of the banded gneissic complex and the Bundelkhand gneiss, as their mutual junction is everywhere concealed by a broad syncline of Aravallis resting on both of them unconformably. In a recent paper in *Current Science*[1] by Mr. W. D. West, it is stated that they are thought to be equivalent. This, however, is the case only in the sense that both are overlain unconformably by the Aravallis, for they are entirely different lithologically. The Bundelkhand gneiss is a true granite, unfoliated except in its extreme western extension, non-porphyritic, and remarkably uniform over all its wide area of outcrop; it is traversed by intrusive dykes of dolerite and great reefs of quartz. The banded gneissic complex, on the other hand, was originally a sedimentary formation, predominantly argillaceous, but showing by two anticlinal inliers of massive bedded quartzites that its oldest visible strata were arenaceous. Over most of its extent, however, especially in the south, its sedimentary character has been obscured by the intrusion of multitudes of acid and basic rocks in great variety of texture and of different ages, giving rise to a complex of banded and foliated gneisses. In the north the banded character is on the whole less strongly marked and the intrusions are more in the form of large bosses of a dark porphyritic biotitic granite, usually strongly foliated, with its cognate pegmatite and aplite veins forming composite gneisses, and masses of basic rocks.

To the north-west of the synclinorium a third type of gneiss, a fine-grained and usually homogeneous granite, is present at

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[1] *Current Science*, 1934, **3**, 138.

Jodhpur. Memoir, Geological Survey of India, XXXV, Pt 1. Records, Geological Survey of India, LXV, Pt. 4.	*Mewar, Ajmer-Merwara* (Main Syncline).	Unmetamorphosed rocks of *Chitor, Nimbahera* and *Sadr.*	*Jaipur.* Records, Geological Survey of India, XLVIII, Pt. 4 and LIV, Pt. 4.	*Alwar.* (North-Eastern Rajputana), Memoir, Geological Survey of India, XLV, Pt. 1.
Vindhyans of Western Rajputana.		Upper Vindhyans. 'Semri Series' (Lower Vindhyans).		
Malani volcanic series.			Ajabgarh series.	Ajabgarh series. Hornstone breccia. Kushalgarh limestone.
	Delhi System. 'Calc-gneisses.' 'Calc-schists.' Biotite-schists. Quartzites. Basement arkose grits.	Jiran. sandstone / Fault / Sawa shales and grit.	Alwar series.	Alwar series.
	Raialo Series. Garnetiferous biotite schists.	Boundary		
Raialo (Makrana) marble, limestones of Ras.	Raialo (Rajanagar) marble. Local basal grit.	Raialo (Bhagwanpura) limestone.		Raialo limestone. Kalalo quartzite.
Unconformity not seen.				
Shales (Sojat). Schists of Godwar.	*Aravalli System.*	Khardeola and Kanoj grits, Badesar quartzites. Vague unconformity.		
	Phyllites, cherty limestones, quartzites and composite gneisses.	Ranthambhor quartzites. Shales and cherty limestones.	Binota shales.	Limestones and schists of Baswa and Rajgarh.
Unconformity not seen.	Basal quartzites, grits and local conglomerates. Local thick volcanic series.	Great / Basal quartzites and grits.	Quartzites and schists of Baonli—Awan ridge and Bechun, Jiana and Lalsot hills. Volcanics of Basi. Schists of Rajmahal.	Quartzite and conglomerate of Rewasa.
Grey homogeneous gneiss.	Banded gneissic complex.	Bundelkhand gneiss.	Gneissic granite of Karela and Ganor.	

the edge of the Marwar plain, but is much obscured by the Erinpura granite intrusive in it, and by alluvium. It is clearly older than the Delhis but the Aravallis have not been seen in association with it.

The Aravalli system consists predominantly of an immense but immeasurable thickness of phyllites, in certain zones of which impure limestones and fine-grained quartzites occur. Its base is marked by a thin grit resting on the underlying gneisses, and in two widely separated areas thick basic amygdaloids and pyroclastics have been accumulated near the base, in one case passing up into a great series of conglomerates, and these again into massive quartzites.

A feature of great interest is the occurrence, south of Chitor in south-eastern Mewar, of a tract in which the Aravallis have undergone hardly any metamorphism, being still shales with low rolling dips. As they are followed across the strike from east to west, in the direction of the ancient belt of mountain-folding and igneous intrusion of the synclinorium, dips steepen and they become successively slates, phyllites and ultimately mica-schists with small garnets, magnetite, staurolite, chiastolite and kyanite. The intruded dolerite becomes epidiorite and hornblende-schist.

At the top of the little-altered Aravallis are several quartzite and grit formations, of very limited extent and somewhat obscure relationships, to which have been given local names. Some of them (the Badesar quartzites, the Kanoj and Khardeola grits) appear to be slightly unconformable upon the Aravallis; others, the Ranthambhor quartzites, which are found in eastern Jaipur as well as in south-eastern Mewar, are conformable with the Aravallis.

The suggestion is made that the Gwaliors may also be unaltered Aravallis, like those just mentioned, which, like them, have escaped metamorphism owing to their distance from the protaxis of diastrophism now represented by the Aravalli range and by the protection of the solid mass of Bundelkhand gneiss upon which they rest.

Intrusive igneous rocks in the Aravallis are scarcer than in the pre-Aravalli gneisses and in the Delhi system. In the unaltered Aravallis they comprise the dolerite mentioned above, which may perhaps be the hypabyssal equivalent of the Khairmalia amygdaloid at the base of the Khardeola grits, and in the metamorphosed Aravallis to the west they are granite and ultra-basic rocks. The granite, acid, fine-grained and almost devoid of mica, forms several bosses near Udaipur City; on their margins intrusive relations with the Aravalli limestones are excellently shown, and the granite, by *lit-par-lit* injection of the mica-schists, gives rise to a broad band of composite gneiss which runs south-east from Udaipur City[2] for many miles. The ultra-basics are talc-serpentine-chlorite rocks occurring near Rakhab Deo[3] and at other places. The post-Delhi Erinpura granite also invades the Aravallis south-east of Salumbar.

The Raialo series is the thinnest and simplest of the four formations discussed, consisting of a thin, occasionally conglomeratic quartzite at the base, which, however, is more often than not missing, then about two thousand feet of white crystalline limestone, with at the top of the sequence but exposed in one area only, in the core of the syncline (see below) near Kankroli, an unknown thickness of garnetiferous biotite-schist.

A correlation has been made between the widely separated exposures of massive white crystalline limestone which are believed to belong to this series, near Raialo on the frontier between Jaipur and Alwar States, a great syncline running out from below the base of the Delhis past Nathdwara and Kankroli and extending as long narrow synclinal outliers beyond Bhilwara to the Jahazpur and Sawar hills near Deoli, the celebrated Makrana marble in Jodhpur State, with other outcrops along the strike to the south-west and, in the south-eastern Mewar area of unaltered Aravallis, the "Bhagwanpura limestone". In the Makrana and other occurrences to the north-west of the Delhi synclinorium the limestone is a calcium carbonate rock, in those to the south-east of the synclinorium it is dolomite.

The limestone is very free from igneous intrusions, only a few dykes of the post-Delhi pegmatite penetrating it, but the garnetiferous biotite-schists which overlie it give excellent examples of how various types of gneiss arise from the injection of one original rock. Starting from biotite-schist intruded by large definite dykes of pegmatite, these may become so numerous that they crowd into each other leaving little schist, or they may take the form of

[2] *Mem. Geol. Surv. India*, 1934, **65**, pt. 2, 152-153.

[3] *Rec. Geol. Surv. India*, 1933, **65**, pt. 4, 453.

clusters of sills, ending in the schist being intimately and uniformly permeated by multitudinous interfoliar veins, forming a banded composite gneiss often highly contorted. There is no evidence that the Raialos were invaded by any igneous rocks of post-Raialo but pre-Delhi age.

The rocks of the Delhi system are exposed in a great synclinorium which extends throughout Rajputana from north-east to south-west, disappearing beneath the Indo-Gangetic alluvium at the one end at Delhi, and under the alluvium of the Gujarat plain at the other, in Idar State. The north-western flank of the synclinorium is a straight line but its south-eastern side is a great curve; in the medial portion of this, for about forty miles along its length, the synclinorium is a simple syncline about six miles wide but to north and south of this it widens greatly by the development of numerous isoclinal folds.

In the southern portion the base of the Delhi system is exposed as a simple curve without re-entrants, as the present surface of erosion cuts only the higher portions of the folds and therefore the upper formations only, in the synclinorium itself. In the northern portion, however, the basal beds are repeated in great curves running athwart the general direction of the axes of folding, the anticlines pitching to the north-east. We find that the uppermost divisions of the Delhi sequence are more fully preserved in the southern part of the synclinorium than in the northern.

South-west of Ajmer the synclinorium consists of two synclines of Delhis separated by a tongue of the pre-Aravalli banded gneissic complex. They are brought together to the south-west by a thrust-fault, and beyond their point of meeting the north-western of the two synclines is so much intruded by epidiorite and Erinpura granite that it is ultimately obliterated at about where the other, south-eastern, syncline becomes the sole component fold of the synclinorium and so persists, as I have said, for a distance of about forty miles along its length, with a breadth of some six miles. This decrease in width is in part due to the smoothing out of minor folds and in part to the Alwar series at the base of the Delhis having almost died out for a space, to reappear again to the south.

South of the constriction the synclinorium widens again owing to additional folds appearing, to the coming in again of the Alwar series in force and also to deeper plunging synclines bringing in the highest beds of the central core. Here also igneous intrusion, principally the Erinpura granite, increases towards the south-west, obliterating the component formations *en echelon* from west to east until in Idar State only the Alwar quartzites are left where the synclinorium disappears below the alluvium of Gujarat.

In the northern part of the synclinorium both the strong quartzites and the basement grits of the Alwar series are in force, the latter becoming coarse conglomerates with strangely flattened and elongated cobbles at Barr and Srinagar. As a rule the basement beds here are arkose, the felspar being derived from the abundant granitic material in the pre-Aravalli gneisses upon which they rest unconformably.

South of the constriction the basement beds of the main synclinorium are fine-grained quartzites with intercalations of biotite-schist, as they are derived from the underlying Aravalli phyllites, which yield on disintegration no coarse felspar and no pebbles. Out to the east, however, is a line of faulted outliers of the Alwar series, in which arkose conglomeratic grits are strongly developed, as they rest upon the granite-intruded pre-Aravalli gneisses.

The Kushalgarh limestone[4] and the closely associated Hornstone Breccia, which in Alwar State separate the Alwar series from the Ajabgarh series, are not found outside Alwar.

In the country now described, *i.e.*, from the Sambhar Lake southwards, the lowest division of the Ajabgarhs is typically a great thickness of biotite-schists intruded with pegmatite in massive dykes and sills, and with aplite in veins and *lit-par-lit* injection; as a rule there is as much igneous material present as sedimentary, and excellent examples are seen of the transition from phyllite through biotite-schist to composite gneiss formed by the interfoliar permeation of biotite-schist with aplite.

The middle division, the "calc-schists," in their least metamorphosed phase are calcareous shales and impure limestones, seen only in two narrow synclines folded into the Alwar quartzites in the extreme south. These form the Mundeti series[5] of Middlemiss. Except in these two narrow

[4] *Mem. Geol. Surv. India*, 1917, **45**, pt. 1, 56-72.

[5] *Mem. Geol. Surv. India*, 1921, **44**, pt. 1, 53-61.

synclines and the isolated exposures of the "Mundeti series" in Idar, the "calc-schists" attain a higher degree of metamorphism, and have a surprisingly uniform character throughout their great length of outcrop. They are straightly banded, flaggy rocks, the banding being certainly the result of the original stratification and is now due to the alternation of dark layers rich in biotite and actinolite with pale layers of felspars, tremolite and diopside. The amount of igneous intrusion is generally less than in the case of the biotite-schists, and it occurs more as large sills and dykes of pegmatite, *lit-par-lit* injection being scarce.

The upper division of the Ajabgarhs, the "calc-gneisses," in its less altered phase in the north-east is a series of dark, banded biotitic and siliceous limestones, passing gradually along the strike to the south-west into "calc-gneisses". In these the banding, which is essentially the same as the banding in the original limestones, is broader and more variable in composition and in width than in the "calc-schists" and is more irregular, often being characterised by extraordinary contortion. In the "calc-gneisses" bands composed largely of carbonates (calcite and dolomite) alternate with bands rich in silicates (felspars, diopsides and amphiboles), the former being more soluble than the latter, which stand out in relief on weathering. In both "calc-schists" and "calc-gneisses" the present banding is essentially the same as the original stratification but metamorphosed; this consisted of alternating layers of calcareous sediment with argillaceous and ferruginous sediment.

The earliest intrusives in the Delhi system are epidiorites and hornblende-schists, originally basalts and monzonites, which are in particular abundance along the north-western flank of the synclinorium. Ultra-basic rocks are represented by talc- and chlorite-schists and by a group of small plugs of unfoliated talc-limonite-serpentine-magnesite rock, probably much younger than the former schists.

The principal post-Delhi intrusive is the Erinpura granite, in bodies of all sizes, and with wide variations of texture and degree of foliation. Its earliest forms were probably aplite veins and foliated granite sheets, followed by stocks and batholiths of larger sizes, composed of granite coarser in grain, more biotitic and often unfoliated; the last manifestation was the widespread pegmatite swarms.

Later than the Erinpura granite and earlier than the Malani volcanic series is a suite of basic and ultra-basic rocks found by Coulson[6] in Sirohi State, comprising picrite, pyroxenite, gabbro, dolerite and basalt. It also includes a sodalite-syenite; this is quite distinct from the soda-syenites[7] of Kishengarh State at the other end of the Aravalli range, which are probably pre-Delhi in age.

The Jalor and Siwana granites with their granophyres, porphyries and rhyolites, form the Malani series,[8,9] which has a wide development on the plains to the west of the synclinorium. The Idar granite of Middlemiss,[10] which was formerly supposed to be the same as the Jalor and Siwana (Malani) granites, has at the end of this field-season been traced into continuity with the main Abu-Erinpura batholith of the Erinpura granite, and the outcrops of the Malani series are thus confined to the west of the synclinorium and the Aravalli range.

Youngest of all is the dolerite which cuts the Delhis and the Malanis in a few plugs and dykes and may perhaps be related to a dolerite which intrudes even the Semri series or Lower Vindhyans far to the east in Mirzapur district.[11]

The Delhi system is characterised by a greater variety and abundance of igneous intrusives than either the Aravalli system or the Raialo series and by the fact that its sedimentary rocks usually attain a higher grade of metamorphism, particularly in the south-western part of the synclinorium, than the much older Aravallis outside it. It is believed that the plethora of intrusions was not to any important degree the *cause* of metamorphism but that the rocks of the synclinorium had reached their present metamorphic stage before the almost universal pegmatite, at any rate, had pervaded them. The Erinpura granite has, it is true, in some places produced local extra metamorphic effects on the calc-gneisses, but both calc-gneisses and calc-schists are uniformly in their usual highly metamorphosed

[6] *Mem. Geol. Surv. India*, 1933, **63**, pt. 1, 77-101.
[7] *Rec. Geol. Surv. India*, 1924, **56**, pt. 2, 179-197.
[8] *Mem. Geol. Surv. India*, 1902, **35**, pt. 1, 19-25.
[9] *Mem. Geol. Surv. India*, 1933, **63**, pt. 1, 102-141.
[10] *Mem. Geol. Surv. India*, 1921, **44**, pt. 1, 115-126.
[11] *Mem. Geol. Surv. India*, 1933, **62**, pt. 2, 191-193.

state over great areas and at great distances from any body of Erinpura granite.

Pegmatite veins were never seen to produce any marginal effects on the calc-gneisses and calc-schists, and in considerable areas free from pegmatite they do not differ from those in tracts riddled with pegmatite. Though not cause and effect, igneous intrusion and metamorphism are doubtless related in both being effects of the same cause,—deep folding by which the rocks were brought within the range of high temperatures and pressures and into contact with rising granite magma.

The Delhis appear to have been deposited in a geosyncline which was subsequently laterally compressed and elevated into a mountain range, the deeply folded roots of which are now laid bare. The two major unconformities, at the base of the Aravallis and at the bases of the Delhis and Raialos respectively, were of sufficient magnitude for the underlying formations to be highly folded and for deep-seated plutonic masses to be laid open by denudation. In the Raialo-Delhi interval similar folding took place but no post-Raialo and pre-Delhi igneous rocks have been detected.

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Additions to the London Zoo.

WE learn that the Prince of Wales presented to the mammalian section of the London zoo a giraffe-like specimen commonly known as the Okapi. This animal is known to the zoologists from a long time and we read that Sir, H. Johnston made a present of the skin, two skulls and the bones of the feet of a new genus of Giraffidæ secured from the Belgian Congo to the Nat. Hist. Society, London, as early as 1900. On examination this turned out to be the new genus *Ocapia johnstoni*. The genus *Ocapia* contains a single species *O. johnstoni*. Peculiarly, however, the animal which is about the size of a Sable antelope, incorporates in itself the striped side skin of the Zebra on its hind and forelimbs and the head of the giraffe *minus* the horns. The body and tail are coloured uniformly reddish brown. Naturalists tell us that he is a very shy creature and exhibits a predilection for choosing the thick recessus of the forests, but always lives in pairs. As regards the position of the animal in the scale of evolution, we know from the study of the skull that it is intermediate between that of the giraffe and that of the extinct Samotherium of the lower Pliocene of Europe.

The rare and proverbial blood-sucking bat—the Vampire—is a native of tropical America. Though small in size, it possesses a sharp set of teeth by means of which it is capable of inflicting painless wounds and then "licks" the oozing blood by means of the tongue with such rapidity that a regular sanguinous stream is seen to enter the mouth. For a long time the use of the long thumb was not known and now after a careful study Ditmar tells that it is used as feet for progression on the ground.

Wood Preservation in India.

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IN spite of all the efficient salesmanship and propaganda of cement and steel interests in India, wood is still very widely used for construction purposes. At the same time, for some years, wood has been gradually losing ground as a structural material. When timber was more plentiful, and steel and cement were less easily available and were more expensive, the urge for its proper use was not so apparent. In these days of competition, wood is used only in places and for purposes where it is not only initially less expensive than steel and cement, but where it is also cheaper in the long run. If a much longer life than what can be obtained with most raw untreated timbers of India cannot be secured, wood will be rapidly ousted out of the structural field. It is this aspect that brings us face to face with wood preservation by the application of physical and chemical principles. Naturally non-durable wood has to hold its own not only against non-cellulosic structural materials that are available in the market, but against the more naturally durable timbers.

A tree saved is a tree grown. It is wood preservation that makes one tree serve the purpose of even four or five trees, as with most Indian timbers, wood preservation augments the life by 400 to 500 per cent. Hence the wood preserver is not only aiding forestry, but is making forestry pay by the conservation of forest resources, and by the elimination of waste to a minimum.

What is a handicap with raw untreated timber becomes an asset when once wood preservation is employed. The so-called "katcha" timber for which people hardly pay anything in the timber-yard at present becomes very much more valuable than the expensive heartwood when once it is chemically preserved, as being almost invariably much more porous, it absorbs more preservative and to a greater depth. The aristocratic position held by the naturally durable timbers like teak and deodar in India is due to a poison with which they are endowed by Nature. In a scientific age like the present, tables have been turned by creative chemistry against a number of natural materials by superior and artificial materials that are more suitable and efficient for coping with certain specific conditions encountered in practice. When once timber is submitted to modern wood preservation processing, most of the porous timber that is despised and rejected at present will be more valuable than the so-called hard and durable timbers which cannot be filled up by impregnation with fire-proofing chemicals, dyes, etc. While the ordinarily despised pine can be fire-proofed, teak cannot be.

There are in the Indian forests several woods that are mechanically strong for almost any structural purpose, and stronger than pine and fir which have been widely employed for even railway bridge construction in the United States of America and Canada, but owing to their want of resistance to white ant and fungus attack, they are not used for construction work. In some cases, wood has got a bad name by its having been used unwisely. It can give only a short life if not chemically preserved. The same is the case with leather. Raw hides perish very much more rapidly than tanned skins. Unpainted or ungalvanised steel or iron perishes rapidly in a moist climate. Even cement concrete, unless special chemicals are included and unless properly made and cured, cracks under frost, and the cement is dissolved out if it is in contact with water for several years. Even the best of structural materials requires some kind of protective chemical treatment for resisting the disintegrating forces of Nature.

Besides fire, the two most important agents that tend to destroy wood, especially structural timber during service, are wood-boring insects and fungi. As iron and stone disintegrate through inorganic processes, unprotected wood is destroyed through decay. It is only Nature's cycle of creation and destruction that is incessantly going on. Decay is caused by low forms of plant life which, being incapable of photo-synthesis, feed on carbohydrates that have already been formed and are available. They produce an acid that dissolves organic substances, facilitating assimilation. The four requirements for the growth of fungi are oxygen, moisture, a favourable temperature and food. When submerged in water, or in the earth below the " level of water of saturation", wood has been known to last hundreds of years. In perfectly dry

situations, it is not affected by fungus for an almost indefinite period. A damp condition, accompanied by poor ventilation, offers very favourable conditions for fungus attack. It is for this reason that timber fence posts and joints, where water tends to stagnate, etc., decay rapidly. Wood destroying fungi cannot grow at very high or very low temperatures. There is hardly any wood destroying fungus that can live above 40° C. while very few can live below 15° C. Most fungi—especially the so-called "wet" fungi like *Coniophora cerebella*—grow vigorously between 20°C. and 25° C. A few of the so-called dry fungi like *Lenzites thermophila*, which attack the tops of poles and posts, thrive vigorously between 30° C. and 35° C.

The wood itself supplies the fourth requirement—namely food. It is interesting to note that some fungi attack only the cellulose component of wood while others the lignin component.

To prevent fungus attack, it is obviously necessary to deprive it of one or more of the four above mentioned requirements. In all outside locations and in most indoor locations, it is impossible to deprive them of air, or to keep them at a very high or very low temperature. The best and most practicable way is, therefore, to poison the food supply. This is the principle on which successful wood preservatives are based.

Wood-boring insects, including white ants, attack timber almost irrespective of its moisture condition, although a certain minimum moisture content in wood appears to induce insect attack more readily. The action of wood preservatives on wood-boring insects is similar to that on fungi which cannot feed on poisoned wood without being killed.

Modern wood preservative treatment performs three kinds of service. Firstly, it increases the durability life of wood by over two or three decades even on exposure to very severe conditions saving several times the cost of replacing the structure, and the inconvenience involved in such frequent renewals. Secondly, it makes the present worthless sapwood even more durable than the heartwood of even the most naturally durable species. This removes the necessity for imposing restrictions on sapwood content and distribution in structural timbers. It, therefore, permits closer utilisation. Thirdly and lastly, it enables our so-called junglewoods and poles in the round, which are invariably of low natural durability, to be used widely for construction purposes.

A successful wood preservative should be toxic enough to kill wood-boring insects as well as fungi. It must be available in large quantities and be of uniform composition. It should be also not high-priced. Also, the preservative should neither volatilise nor get washed out from wood when exposed either to running water or to moist soil.

There are several wood preservatives on the market to-day. The Forest Research Institute, Dehra Dun, has tested several dozen wood preservatives against fungus and white ants during the last about 25 years. Most of the preservatives that were tested gave good results for the first year or so, but owing to either volatilisation or leaching, the treated specimens of wood commenced to fail rapidly after that period.

Generally speaking, there are two kinds of wood preservatives. One kind is represented by oils like coal tar creosote. Such preservatives are almost insoluble in water, but tend to volatilise. Coal tar creosote has given excellent results as a wood preservative, but is very expensive in India besides giving out a pungent odour. The other class consists of water-soluble salts. These are very useful for outside moist locations only if they can be "fixed" to wood. Five of the most important inorganic elements that have been employed with success in the past are zinc, fluorine, mercury, copper and arsenic. The first two elements have not been found to be very effective against white ants, while proving efficient against fungi. They are, therefore, almost useless for Indian conditions. The mercury wood preservative is too expensive compared to the remaining four, and also cannot be employed for pressure impregnation in steel cylinders. Therefore, our choice falls on copper or/and arsenic.

On account of wide variations in temperature and humidity in India, wood, almost invariably, splits under service conditions so that as deep a penetration of the preservative as possible should be secured if treated wood is to give efficient service in outside locations. This necessitates a pressure impregnation. The most recent experience in India and abroad has demonstrated that for a unit of money, an optimum combination of copper and arsenic affords the most efficient protection to wood against white ants and fungi. Such a preservative, to be successful, should not only be easily soluble

in water, but while forming a compound in wood that is almost insoluble in water, like limestone, the compound should be soluble to form a lethal dose, in a very dilute acid of a pH-ion concentration of between 4 and 5, an acidity corresponding to that produced by wood destroying fungi when they attack and assimilate wood substances in Nature. It may be stated that the acidity corresponds to about $\frac{1}{3}$ per cent. concentration of concentrated acetic acid in water. The preservative should not only be stable in contact with steel and cement, but should not corrode steel. A successful wood preservative satisfying all the above conditions was recently developed by the writer at the Forest Research Institute, Dehra Dun. It is called *Ascu*.

The next aspect that merits consideration is the method of applying wood preservatives. Generally speaking, there are three methods. The preservative may be either impregnated under mechanical pressure, or be introduced into wood by allowing it to soak for several hours in the preservative fluid. A third method of application is either with a brush, or a spray pump. Where timber is employed in sheltered locations, if it has been well air-seasoned to start with, it can be treated with success either by soaking or brush-painting. For use in outside locations as with railway sleepers, especially when timber is partially buried in the earth, as in the case of a pole or post, it should be pressure-treated for obtaining the best results. Otherwise, timber splits and cracks. The planes of cleavage thus formed will serve as channels for the ingress of white ants and wood destroying fungi spores.

From the point of view of distribution and content of preservative fluid in wood cells, there are two general methods of wood preservative impregnation, one is the "full-cell" impregnation in which the cells, after displacing the air in them, are filled by the preservative fluid. In the "empty cell" processes—the second general method—wood cells are only lined with a coating of the preservative so that by employing them, a considerable saving in the cost of preservation results. Up to about 80 to 90 per cent. of the preservative originally introduced under pressure can be recovered. Each method has got its own field of application. While in the "full-cell" processes, exposing the timber to a vacuum, or boiling it in a vacuum are the common lines of procedure; in the "empty-cell" processes, either the air that is contained in wood is compressed by superimposed hydraulic pressure, or air from outside is injected under pressure into wood before the antiseptic fluid is forced so that a high pneumatic pressure is, initially, created in the wood. When the superimposed hydraulic pressure is broken, compressed air inside the wood comes out rapidly bringing with it a large quantity of the antiseptic fluid that has gone in due to the hydraulic pressure. The two most popular "empty-cell" processes are called after Lowry and Rueping, the latter having the distinction of being the inventor of the most effective "empty cell" process—which involves the initial injection of air into wood—known to-day.

If the best service is to be obtained from treated timber, not only expert technical advice is necessary as regards the selection of the most suitable wood preservative, but also regarding the most efficient and economical method of treatment. Several specifications for treatment as well as preservatives are known. A selection is imperative. A thorough knowledge of the structure of the timber to be treated is essential. Also, considerable experimentation regarding the treatment characteristics of the timber in question is a necessary prelude for obtaining the best results.

As far as India is concerned, about a hundred of the more important commercial timbers and bamboos have been subjected to investigation during the last twelve years by the Wood Preservation Section of the Forest Research Institute so that the public may write for advice regarding any problem connected with the preservative treatment of Indian timbers and bamboos.

The next factor that requires consideration is the cost of antiseptic treatment. Usually actual cost of pressure treatment which includes interest and depreciation on the investment on the erection of a suitable plant, the cost of handling timber in the yard, etc., works out at about 2 annas to 4 annas per cub. ft. whereas the actual cost of the preservative is very variable. In the case of most preservatives, it varies between 2 annas and 8 annas per cub. ft. With the soaking and brush treatments which are not very effective for outside locations the cost of treatment is naturally very much less.

Timber or bamboos can also be "fire-proofed" which enables the cellulosic material to resist the tendency to burn. The material merely chars so that the charred portion

protects the interior strata from combustion. The three main principles underlying an effective fire-proofing treatment are the impregnation into, or application to, wood of a chemical that would either form a kind of glassy material by fusing on exposure to heat, and thus prevent the access of oxygen to the wood, or will liberate either water vapour or inert gases when the temperature of the wood rises above 150°C. or 200° C. As the water vapour or inert gases dilute the oxygen around the timber, combustion is retarded. The most popular and representative fire-proofing chemicals are sodium silicate, borax and ammonium salts. The practical method of fire-proofing timber is similar to preservative treatment. The cost is also about the same per cub. ft. Some of the more important uses to which chemically preserved timber can be put to with economy not only initially, but in the long run in India are noted below :—

1. *In the railways.*—Sleepers, crossing-planks, roof-trusses, posts, joists, ceiling, planking, doors, windows, partitions, fences, trestle bridges, overhead and foot bridges, culverts, telephone and signal poles, sign-posts, carriage and wagon superstructures, conduit planks, cooling structures, platforms, bulk-heads, water tanks, pile foundations, flooring planks, paving blocks, etc.

2. *In the highways.*—Truss bridges, trestle bridges and bridge approaches, culverts, sign-posts, bulk-heads, retaining walls, guard rails, fence posts, bridge floors (especially of pontoon bridges), etc.

3. *Overhead electrical construction.*—Transmission, distribution, lighting, telegraph and telephone poles, cross-arms, insulator pins, pole struts, guy-blocks.

4. *Building construction.*—Pile foundations, doors and windows, joists, rafters, wall-plates, sub-floors and floors, shingles, roof-trusses, garden structures, summer houses, garages.

5. *Rural construction.*—Posts, poles, bamboos, rafters, joists, flooring, cart-wheels, doors and windows, cattle shed roofs, poultry houses, aqueducts, irrigation channels, garden creeper and vineyard stakes, bamboo supports to sugarcane and other crops.

6. *Factory and mill construction.*—Roof-trusses, building timber of various kinds, wood tanks and chutes, etc.

7. *Marine construction.*—Wharf and pier timbers, fenders, sleepers, roof-trusses, ship and boat building, breakwaters, causeways, overhead bridges, loading docks, etc.

8. *Mine construction.*—Head-frames, shaft houses, gallery lining, tipples, sleepers, coal bunkers, flumes, trestles, tanks, conduits, electrical supports, permanent haulage ways, etc.

The relative economy of treated timber in India may be gauged from the fact that while any species of timber has, weight for weight, about the same strength as iron and steel, it costs, especially in the round, only a fraction as much as metals. Also the cost of working timber is considerably less than that with metals. Since in most cases, even in outside locations, as properly treated timber can be confidently expected to give a life of about 25 to 30 years (a period which synchronises with the "obsolescence" period of most structures), treated timber appears to be not only the most up-to-date structural material but the most efficient and economical building material in India. In these days of engineering and scientific progress, accompanied by a corresponding rapid change of æsthetic ideas and fashions, there is a very strong case for the use of chemically preserved wood in India for structural purposes. Commercial wood preservation has just been born. The Indian Railways and the Mysore Government have treated in their pressure plants several lakhs of railway sleepers and electrical poles. The Government of Madras have been operating, for some time, two small *Ascu* wood preservation plants. The Government of Travancore are putting up shortly a large wood preservation plant. The Government of Bhopal will be shortly using several thousand cub. ft. of *Ascu*-treated timber. The Government of the United Provinces are installing a few thousand electrical distribution *Ascu*-treated poles. The *Ascu* Wood Preserving Agency, the only private wood preservation company, has been operating two large wood preservation plants in Northern India.

With efficient and extensive organisation, wood preservation will prove to be a great blessing to this tropical country, where fine timber is not only a rapidly growing crop, but cheap and efficient wood-working labour is available throughout the country.

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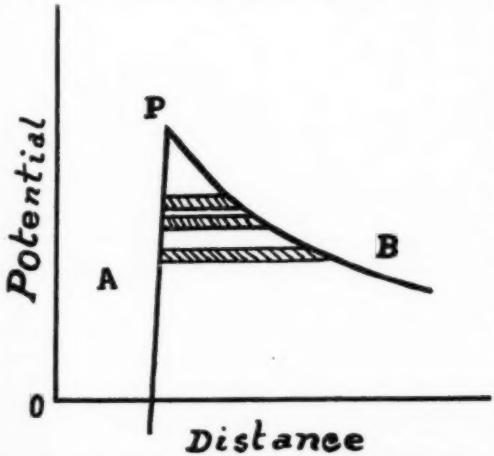
A Note on the Potential Barrier.

In developing the theory of spontaneous disintegration of α-particles from radioactive substances, Gamow has introduced the idea of a potential barrier in the nucleus. It is assumed that within the nucleus the potential varies as shown by the curve.



Thus at a nuclear distance greater than OP the potential is Coulombian varying inversely as the distance. On the other hand for distances less than OP the potential decreases with the distance.

The α-particles are packed within the region OP. If by some means an α-wave crosses the peak P of the potential wall, it will be set free by the Coulombian repulsive force. To explain this crossing, Gamow has to fall back on Heisenberg's *Principle of Uncertainty*. But it appears to me to be fallacious to apply Heisenberg's principle to this case. The rate of disintegration, however small, has a definite value. It is a phenomenon known with a certainty. It is not, therefore, proper to take help of the uncertainty principle which gives a measure of the "unknowable" to explain what is known definitely with definite experimental values. Moreover, if a theory based on the "certainty principle" is available it would be scientific to give it preference to the one developed on the basis of the "uncertainty principle".

After Gamow's theory Born, Sexl and others deduced a similar formula on assuming the reflectivity and the transmissibility of the barrier. Obviously there can be no objection, as in Gamow's theory, to such an assumption. However, in all these wave-mechanical theories it is assumed that

the energy of the disintegrating α-particles is partly real and partly imaginary. The assumption of particles having imaginary energy is certainly open to criticism. In a recent paper on the subject Sexl[1] has suggested that one has to make the above assumption because the waves within the nucleus are damped.

Before Sexl's paper, just mentioned, was published the writer[2] had developed the wavestatistical theory of disintegration. It was assumed that, on account of a very high value of density, the phase space corresponding to the hard core of the nucleus is viscous. Due to the viscosity, the hydrodynamical waves in the phase space are naturally damped. The theory, it may be noted, has been developed only on the above assumption which is perfectly justified. No assumption regarding imaginary energy is necessary. Further, in so far as a definite nuclear property causing disintegration is assumed, the theory is free from any "uncertainty objection".

In developing the wavestatistical theory the writer has followed Rutherford's model of nucleus. However, it may be mentioned that now-a-days the picture of potential barrier seems to be replaced by Rutherford's model. But it can be easily seen that there is close agreement between the two. It is evident that the sphere of radius OP is Rutherford's hard core, where the whole of the nuclear charge is collected. Beyond OP there is the neutral shell of Rutherford. There are stationary orbits in the neutral shell. And any particle going out of the hard core is caught for a while in one of these resonance levels and *vice versa*. This explains the existence of holes in the barrier as indicated by shades in the figure.

K. C. KAR.

Physical Laboratory,
Presidency College,
Calcutta,
July 15, 1935.

[1] *Zeit. f. Phys.*, 1934, **87**, 105.
[2] *Phil. Mag.*, 1933, **16**, 1097.

Depolarisation of the Light Scattered by Heavy Water.

10 grs. of heavy water supplied as 99·5 per cent pure by the Ohio Chemical Manufacturing Co., is contained in a pyrex glass double bulb which is sealed off after evacuation. The liquid is collected into one of the bulbs from the other by slow distillation. When thus purified, it is found to be quite free from dust. The bulb is painted black all over leaving two small windows for illumination and observation respectively and the depolarisation of the transversely scattered light is measured using sunlight focussed by means of a long focal length lens as incident radiation. The track representing the horizontal component is seen to exhibit a distinct reddish tinge and the depolarisation is obtained as 0·04 after applying a correction for the convergence of rays in the incident beam. This result may be compared with the depolarisation of about 0·06 observed for ordinary water and shows that the heavy water molecule is similar to that of the ordinary water molecule in respect of possessing only a feeble optical anisotropy.

S. BHAGAVANTAM.

Andhra University,
Waltair,
July 12, 1935.

Inhibition in the Benzoin Reaction.

FOR some time this laboratory has been engaged in a study of the kinetics of the benzoin reaction between solid potassium cyanide and benzaldehyde, in the absence of solvents or diluents. It has been shown[1] that two reactions occur, a heterogeneous reaction between solid potassium cyanide and benzaldehyde, and a homogeneous reaction between benzaldehyde and the trace of potassium cyanide which is dissolved by benzaldehyde. This latter reaction is autocatalysed by benzoin and can occur only if benzoin is present.

It has also been shown that the heterogeneous reaction is subject to inhibition in the presence of, for example, potassium iodide or quinol. The inhibition appears to be due to the adsorption of the inhibitor on the surface of the solid potassium cyanide.

This is confirmed by the fact that benzaldehyde contaminated with a trace of an inhibitor can be made to give the normal rate of reaction by allowing it to stand at room temperature in contact with a quantity of solid potassium cyanide too small to produce a measurable amount of benzoin during the time of the purification.

We have now succeeded in showing that with certain substances, inhibition occurs in the presence of small proportions, for example, a fall in the rate of reaction can be detected with benzaldehyde containing one

part in 10^7 of quinone, or one part in 5×10^5 of iodine, or one part in 2×10^4 of sulphur.

Small quantities of water and of certain alcohols accelerate the reaction, but the effect is not so marked as with inhibitors. Acceleration has been detected with, for example, with 1 part of water in 100 of benzaldehyde.

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T. S. WHEELER.

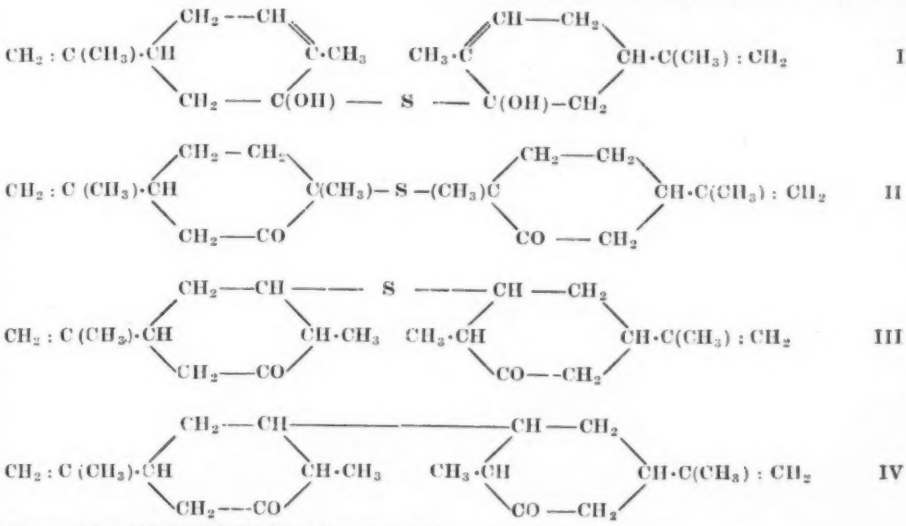
Department of Chemistry,
Royal Institute of Science,
Bombay,
August 2, 1935.

[1] *J. Phys. Chem.*, 1935, **39**, 727, 901, 907.

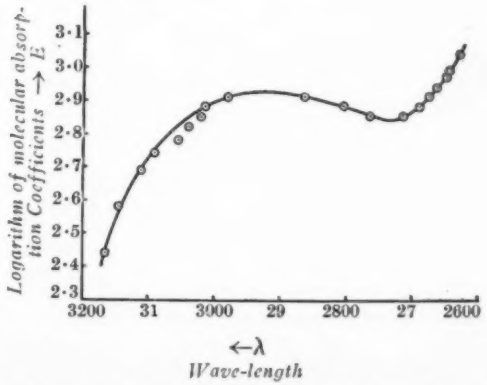
A Note on the Absorption Spectrum of Carvone 'Hydrosulphide' and Its Constitution.

ALTHOUGH the formation of crystalline additive compounds between α-β unsaturated ketones and hydrogen sulphide has been known long since,[1] the constitution of these 'hydrosulphides' is still a matter of some controversy. In the case of carvone 'hydrosulphide' for example, which consists of 1 molecule of hydrogen sulphide and 2 molecules of the ketone, the following structures have been proposed from time to time (I, II, and III).

Of these, Formula I due to Harries and Stirm[2] is based on the non-formation of any oxime, semicarbazone or phenylhydrazone by the compound, while Formula II



put forward by Wallach[3] derives its support from the formation of a dimolecular compound (IV) on addition of hydrogen. The preparation of a dicyanohydrin which readily decomposed to the corresponding dinitrile led Steele[4] to propose (III) for the compound. In order to decide between these alternatives, a quantitative measurement of the ultraviolet absorption of the compound was made with the help of the 'Spekker' spectrophotometer of Hilger. The curve of molecular extinction coefficients given below was obtained with a 1 cm. length of a solution in chloroform of 0·61% concentration. The band at $\lambda = 2900$ Å furnishes direct evidence for the existence of free CO groups in the molecule. The formula of Harries and Stirm is therefore excluded.



Absorption Spectrum of Carvone 'Hydrosulphide'.

The formation of a tetrabromoderivative[5] and the recent work of Hooper, Macbeth and Price[6] on the bis-dinitrophenyl hydrazone of the substance is also in favour of this view. The influence of negative groups like the CO group in making the neighbouring ethenoid carbon atoms more negative is well known[7] and hence the structure proposed by Steele (*loc. cit.*) is put forward as the most probable constitution for carvone 'hydrosulphide'.

R. PADMANABHAN.

Department of Physics,
Indian Institute of Science,
Bangalore,
August 13, 1935.

[1] Fluckiger, *Ber.*, 1876, **9**, 468.
[2] Harries and Stirm, *Ber.*, 1901, **34**, 1931.
[3] Wallach, *Terpene und Campher*, 1909, p. 63.
[4] Steele, *Proc. Chem. Soc.*, 1911, **27**, 240.
[5] Deussen and Ziem, *J. Prakt. Chem.*, 1914, **90**, 318. Challenger, Smith and Paton, *J.C.S.*, 1923, **123**, 1046.
[6] Hooper, Macbeth and Price, *J.C.S.*, 1934, 1147.
[7] Lapworth, *Trans. Chem. Soc.*, 1903, **83**, 995.

Is there a Racial Factor in Metabolism?

RECENT investigations have shown that the basal metabolism of Indians is considerably lower than that of Europeans or Americans and the question has been raised whether a definite racial factor is involved. (*Cf.* Mason[1] who investigated the basal metabolism of South Indian women.) It is interesting to examine, from this point of view, the results of a study made in this Laboratory on the Nitrogen distribution in the urine of South Indians and to see if the metabolic products in the urine show any indication of racial peculiarities. The results quoted in Table I are based on the analysis of the urine of thirty-two normal individuals, including fourteen vegetarians and eighteen non-vegetarians.

The significance of these results from the present point of view is that while the value for Total N. and for Urea-N. (which latter represents the main product of exogenous metabolism) are very low compared to Western standards and indicate a low level

TABLE I.

	Total N.			Urea-N.			Creatinine Coefficient = m.g. Creatinine-N. / Body weight in Kilos		
	Average	Max.	Min.	Average	Max.	Min.	Average	Max.	Min.
South Indian General ..	7·10	11·11	4·11	4·92	9·06	3·02	9·27	12·8	5·56
South Indian Vegetarian ..	6·20	8·26	4·11	4·30	5·18	3·08	8·48	12·8	5·56
South Indian Non-Vegetarian ..	8·01	11·11	4·17	5·54	9·06	3·02	9·95	12·7	7·30
Europeans	18·0	..	..	16·33	..	..	9·0	..	..

of protein ingestion, the endogenous metabolism which is little affected by the nutritional state of the individual and which might be expected to show a racial peculiarity, is, as measured by the creatinine coefficient, not lower than that of Europeans and Americans. Attention may be drawn in passing to the difference in the averages for the creatinine coefficients of vegetarians and non-vegetarians. So far as this small difference is of any significance, it seems to be in keeping with the work of Abderhalden and Buadze[2] and others who have demonstrated a slightly increased creatinine excretion in dogs after feeding certain amino-acids in massive doses and over a sufficiently long period.

As the creatinine coefficient is generally taken as an index of muscular efficiency, it is satisfactory to find that this factor cannot be correlated with the observed low basal metabolism of South India. The views of the earlier investigators on basal metabolism may be summarised in the words of Lusk[3]: "On the basis of the whole of the evidence it does not appear wise to state that the influence of race or a tropical climate may greatly reduce the basal metabolism." Whether this is not, after all, the correct view and whether under-nutrition, such as is shown to exist in regard to proteins by the present study, is not a sufficient explanation for the low values for Indians obtained by Mason

and others can only be settled by carrying out basal metabolism and dietary studies simultaneously on groups of individuals at different levels of nutrition.

M. DAMODARAN.
K. G. ANANTHANARAYANAN.

University Biochemical Laboratory,
Madras,
July 15, 1935.

[1] Mason and Benedict, *Indian J. Med. Res.*, 1931, **19**, 75.
[2] Abderhalden and Buadze, *Z. Physiol. Chem.*, 1930, **189**, 65.
[3] Lusk, "Science of Nutrition," Saunders, 1928, 168.

On the Absorption Spectra of the Halides of Some Elements of the Second Group: $CdCl_2$; $CdBr_2$; CdI_2; $ZnCl_2$; $ZnBr_2$ and $SrCl_2$.

THE absorption spectra of the above halides of the elements of the second group were studied by the same method of experimental procedure as that adopted by R. Samuel[1] and the regions of the maxima of absorption obtained by plotting the values of log K against wave-length. The salts are very hygroscopic and the preparation of solution offered some difficulty as much heat was developed. In the case of $ZnCl_2$ and $ZnBr_2$ a lower concentration could not be prepared as the addition of water precipitated the salt in a form of colloidal solution which dissolved on the addition of a little HCl and HBr respectively showing hydrolysis. The curve for $ZnCl_2$ indicates that it does not obey Beer's law.

Salts	Maxima of Absorption Wave-length in μ	Log K values
$CdCl_2$	.. .. .. 260	.. .. −0·76
$CdBr_2$	.. .. .. 273	.. .. −0·06
CdI_2	No maxima of absorption	
$ZnCl_2$	.. 338−300 (5M) .. 255 (5M strength)	−1·48 −0·28
	255−227 (M/2 „)	−0·48
$ZnBr_2$	.. .. 308.. 276	.. −0·28 −0·08
$SrCl_2$	420 .. 346..312	−1·26 −0·96 −0·69

The above table shows the wave-length of the maxima of absorption of different salts with their log K values.

Details will be published elsewhere.

C. M. BHASKER RAO.
M. KARIM.

Secunderabad,
August 1, 1935.

[1] *Zeit. f. Phys.* 1931, **70**, 43.

A New Device for the Insect Transmission of Spike Disease of Sandal.

IN the course of experiments on the insect transmission of the spike disease of sandal, we experienced a serious shortage of spiked plants having plenty of diseased foliage to serve as the source of infection for the vectors. This difficulty was overcome by conducting the experiments with spiked plants growing under natural conditions in an artificially raised plantation. The plants selected for the purpose offered a branch in a suitably low and oriented position so that the diseased branch could be inserted into the experimental cage, thus providing the source

of infective material. The cage receives also the healthy sandal plant growing in a pot

(Fig.). This method has several advantages over the usual method of providing spiked plants in pots which do not survive the feeding by insects. The diseased branch, on the other hand, being a part of the big plant, is capable of withstanding the attack of the vectors more successfully than the small independent plant with an equivalent amount of branch and foliage. Often, it is advantageous to decapitate the other branches and divert the entire nutriment available, for the vigorous growth of the diseased branch utilised for the experiment. This device has successfully solved the problem of the supply of spiked plants for our transmission experiments and it is hoped that this method may find useful application in the investigation of the other allied diseases.

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Bangalore,
August 5, 1935.

Oxidative Digestion of Organic Nitrogen.

IT was shown in a previous communication[1] that nitrogen in soils and biological materials can be estimated by a process of oxidative digestion. The present note relates to (*a*) the nature of the products formed under such conditions and (*b*) an improved procedure for their inclusion in the estimate of total nitrogen.

The observations may be summarised as follows :—(1) When an aqueous suspension (or solution) of soil or other biological material is heated slowly with dichromate (or chromic anhydride) and sulphuric acid as in the usual procedure for the wet combustion of carbon, there is invariably some loss of nitrogen, the extent of such loss being inversely related to the rate of heating. The mechanism of this loss is still not clear though there is some evidence to show that ammonium dichromate, which is formed as an intermediate product, may undergo slight decomposition, yielding elemental nitrogen. The loss can be avoided, however, by first heating the material to be digested with water and sulphuric acid and then adding the oxidising agent to the boiling (or nearly boiling) mixture. (2) Small quantities of nitric acid are formed during the digestion. This is supported by the independent observations of Narasimhacharya.[2] The quantities are ordinarily too small to appreciably affect the estimate of total nitrogen even if the digest is boiled without condensing the ensuing vapours. On the other hand, the original material itself may contain useful amounts of nitrate which may be lost if proper precautions are not taken. The use of water or air-cooled condenser, as suggested by Narayanayya and Subrahmanyan (*loc. cit.*) helps to retain all the nitrogen in this form. Subsequent reduction of the digest with zinc or reduced iron in acid medium or Devarda's alloy in alkaline medium helps to include all the nitrate in the estimate of total nitrogen. More recently evidence has been adduced to show that even added nitrates can be retained in the digest and accurately estimated by adopting the above procedure. (3) It has already been shown (Narayanayya and Subrahmanyan, *loc. cit.*) that a part of the nitrogen is always retained in the digest and is not released by mere distillation with alkali. Further evidence has been obtained to show that the major part of this nitrogen is present in combination with the chromium in solution and is released on treating the digest with such reagents as are usually employed for reducing dichromate. The nature of the related compound (or compounds) is still obscure. (4) No information is available regarding the mode of association between nitrogen and the insoluble precipitate formed—especially in the case of soil—during digestion. It may nevertheless be mentioned that any nitrogen which may be present in that form is also included in the estimate of total nitrogen by treatment with reducing agents followed by distillation with alkali.

It was suggested by Narayanayya and Subrahmanyan (*loc. cit.*) that the total nitrogen in the digest can be estimated by boiling with zinc followed by distillation with excess of alkali. Unfortunately, all preparations of zinc (including some of the purest specimens) contain nitrogen. In some cases, the nitrogen content may be as high as that of the material to be digested. Reduced iron also contains nitrogen, though the latter is partly removed by pre-treatment with alkali. Since the major part of the zinc or iron is required for the reduction of unused chromic acid, it was considered desirable to use other reducing agents for that purpose. Among the various re-agents

that were tried, alkali sulphites were found to be the most effective.

Based on the foregoing and other observations, an improved method of oxidative digestion has been developed and will be described elsewhere.

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Indian Institute of Science,
Bangalore,
August, 1935.

[1] Narayanayya and Subrahmanyan, *Curr. Sci.*, 1935, **3**.
[2] Narasimhacharya, *J.S.C.I.*, 1935, **54**, 596 (Abstract).

Injurious After-Effects of Sorghum Growing.

WHILE working at the problem of the injurious after-effects of Sorghum in the black soil tracts of the Tinnevelly District, it was observed that, after Sorghum, the soils became much more compact and much harder than after the Spiked Millet and that their permeability was considerably reduced.

When examined in the laboratory, certain striking differences were observed in the cationic composition of these soils the results of which are given below.

It will be seen that—

(i) the exchangeable soda of the soil is greater when cropped with Sorghum than when cropped with Spiked Millet and

Exchangeable Bases in Milliequivalents per 100 *gm. of Air-Dry Soil.*

Head of analysis	Soil depths	Cholam*	Cumbu*	Cholam†		
				Before Sowing	At shot blade	After harvest
Soda	6″—12″	4·03	2·26	1·23	2·98	4·28
Potash	6″—12″	1·11	0·91	0·82	0·86	1·11
Magnesia	6″—12″	11·55	13·96	12·55	13·85	13·53
Total bases	6″—12″	55·31	55·23	56·10	55·70	58·10
Soda	12″—1′ 6″	3·55	2·56	1·36	2·66	3·44
Potash	12″—1′ 6″	0·90	0·95	1·07	1·04	0·99
Magnesia	12″—1′ 6″	14·21	15·35	13·62	12·93	13·48
Total bases	12″—1′ 6″	50·92	50·84	48·00	50·30	50·80

* Average of six samples. † Average of three samples.

(ii) the increase is continuous with the growth of the Sorghum crop.

Sorghum or cholam....*Andropogen Sorghum.*
Spiked Millet....*Pennisetum typhoideum.*

It is not known how exactly this increase in Sodium ion is brought about, but it goes a great way to explain the greater deflocculation and the changes in the physical condition of the Sorghum soils, more particularly their reduced permeability.

In addition, a good deal of evidence has accumulated, in the course of our work, which shows that the explanations usually offered for this phenomenon, *viz.*, soil exhaustion, particularly in nitrogen, toxicity due to the decomposition of plant residues are not in themselves adequate. For example, the injury to the succeeding crop is not seen unless the Sorghum crop is allowed to set seed. Addition of nitrogenous manures like Ammonium Sulphate did not remedy the defect nor did the incorporation of Sorghum stubbles brought from outside, give rise to the adverse after-effects.

It looks as though other causes than those abovementioned are responsible for the injury; the increase in Na-ion is probably one such.

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and
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July 6, 1935.

On a Method of Preparing Large Thin Sections of Plants by Grinding.

IT is a well-known fact that palm-stems show a peripheral crowding of fibro-vascular bundles in their anatomical structure. This

arrangement and the lignification of the sclerenchyma, with the deposition of minerals make the peripheral zone hard and brittle to such an extent in old stems that it is not possible to cut large thin sections by any known means for microscopic examination.

The author while working on the anatomy of palm-stems had to face this difficulty. Various methods for softening such as hydrofluoric acid were resorted to without any success. Ultimately it was thought advisable to harden the entire structure, thus making it possible to grind it to microscopic transparency.

Attempts were made to deposit calcium carbonate and silica inside the cells but it was soon realised that filling the cell cavities with some grindable substance was not enough, as it failed to make the cell walls sufficiently tough to stand the horizontal pull of the grinding. Some substance was required which could be introduced not only into the cell cavities but into the cell wall itself, and later on made to set there with uniform hardness so that it could be ground like a stone. These properties were found in canada balsam, as it is possible to impregnate it uniformly in the whole tissue quickly and without any difficulty with the help of xylol, in which it is miscible in all proportions, and then allow it to set there first by letting the xylol evaporate slowly and then raising the temperature gradually.

For this purpose a transverse slice about 2 mm. thick was cut from a stem with a fine fret-saw. The slice was first boiled in water to drive out all the air and then dehydrated with 50, 70 and 90 per cent. alcohols first quickly and then more slowly, towards 100 per cent. The time varies with the size of the vessels and that of the lacunæ in the ground tissue of the type selected. The whole process up to 90 per cent. takes about 30 minutes. There is practically no harm done by the sudden changes of the grades of alcohol, as the peripheral tissue in palms is always hard enough to sustain the shocks and even the ground-tissue in that zone gets thickened with age. After 90 per cent. alcohol the case is otherwise. The material should be kept in absolute alcohol as long as possible with frequent changes for the purer absolute alcohol. In practice 24 hours are enough. When the dehydration was complete the alcohol was gradually replaced by xylol, and the material was left for another 24 hours in pure xylol. To this, later on, canada balsam was gradually added and the xylol allowed to evaporate slowly in a bath till a syrupy solution remained. The material in the syrupy solution was kept in the drying bath at a temperature of about 50°–60° C. to evaporate the xylol for 24 hours or less (depending on the thickness of the slice and other factors). On the next day the material was fixed on a glass slab with pure hot canada balsam just like a fossil slide. The fixed material was first ground with fine carborundum powder to a plane surface, and then it was unfixed by softening the balsam by heat and again fixed with a ground surface towards the glass. Then the other surface was ground down till the section became sufficiently transparent for microscopic examination. When the required thickness was obtained the carborundum powder was removed from the section by washing with xylol and brushing with an ordinary painting brush. The section was then ready for mounting as a permanent preparation.

Generally it is not necessary to stain the sections as the tissue is found already differentiated in colour but if staining is required then the balsam should be removed completely by constant washing with xylol and then bringing the material into water by passing it gradually through the different grades of alcohol in reverse order.

The author was able by this method to prepare sections for his investigation in comparatively short time and without difficulty. The time usually lost in sharpening razors was utilised in grinding the material and even such hard and thoroughly lignified and mineralised structures as the old stems of *Bactris major*, *Areca catechu* and *Oreodoxa oleracea* gave excellent results. The sections obtained were thin enough to be photographed under a magnification of 50 diameters. Sections prepared by this method are in fact indistinguishable from those prepared by cutting. It is also possible by this method to obtain sections of tissues which are brittle or too fragile to be worked with a microtome. The author has succeeded in getting good sections from a well-developed *Areca catechu* stem, in which case even the central ground-tissue was found to be mineralised. In the accompanying illustration the ground-tissue is shown highly magnified. The perfection of the method will be realised from the fact that the lacunar structure of the ground-tissue is seen intact

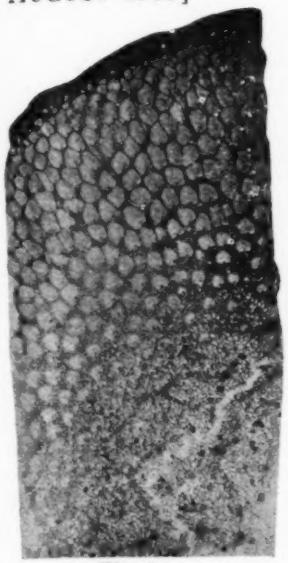


Fig. 1.
Areca catechu. Transverse section showing highly lignified sclerenchyma of the fibro-vascular bundles in the dermal, sub-dermal and the central zones. × ca 2.

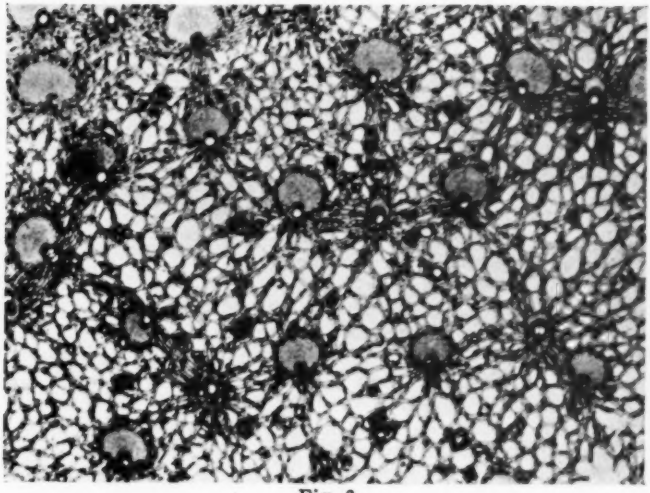


Fig. 3.
The same section. Sub-dermal zone showing the lacunar ground-tissue intact. ×10.

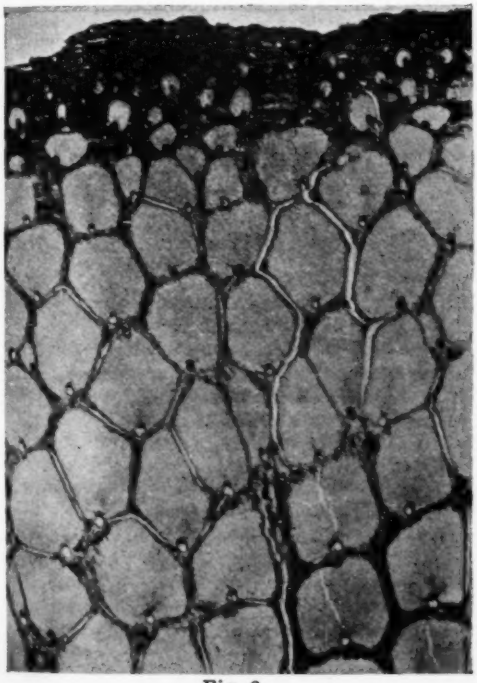


Fig. 2.
The same section. Dermal zone only, showing highly lignified sclerenchyma of the fibro-vascular bundles. × 10.

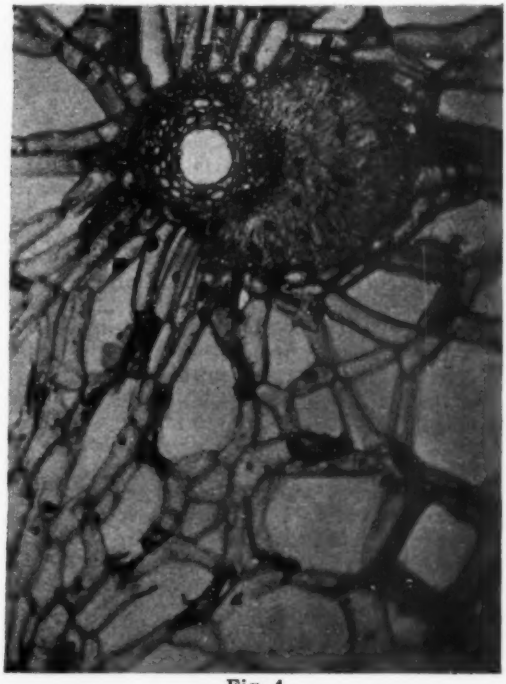


Fig. 4.
The same section. Central zone, highly magnified to show the cell walls of the comparatively soft ground-tissue. × 80.

and from the perfect, unbroken walls of the individual cells.

K. N. KAUL.

Department of Botany,
University of Lucknow,
July, 1935.

"Dionyle P. W." for Rapid Penetration of Fixatives.

IT is well known that plant material containing air, for example, flower buds and leaves, etc., does not easily sink to the bottom of the tube containing liquid fixatives specially in those which do not contain alcohol and thus the process of fixation is not as rapid as it should be. When there is plenty of air within the tissues the material remains floating on the surface for a long time or it does not sink at all. Usually suction pumps or water aspirators are used to get rid of the air but in many cases even these are not of much help.

A French Engineer Chemist, Mr. Auguste Blondon of the firm S.A.P.I.C., 33, Quai de Seine, L' Ile-st-Denis, Paris, has recently manufactured a chemical product in the powder form known as Dionyle P. W. which, if added to any plant fixative, allows the material to settle to the bottom with great ease. I have seen Dr. A. Eichhorn using this chemical very successfully with roots, flower buds, etc. I myself have used it with success for fixing the ærial mycelium of Pythium. Dr. G. Archambault[1] has tried this chemical and is of opinion that it is very good for rapid penetration of fixatives. He compared the sections of plant material fixed with and without Dionyle in the fixatives and found that the addition of the chemical did not produce any undesirable effects. It has some physical action on account of which pieces of roots sink down rapidly in the fixatives, but in case of leaves and flower buds water aspirators may have to be used for about 2 to 5 minutes. Dionyle is an ether salt of β-naphthalene sulphonic acid with butylic alcohol and isopropylic alcohol. It is easily soluble in water and is neutral in reaction. During the process of its manufacture a little sulphuric acid appears which is neutralised by sodium sulphate, which is not bad for fixation.

In fact it is used in Zenker-formaol[2] fixative the composition of which is given below :

Bichloride of Mercury	.. 5·0 gm.
Bichromate of Potassium	.. 2·5 gm.
Sulphate of Sodium	.. 1 gm.
Distilled Water	.. 100 c.c.

To 9 c.c. of this add 1 c.c. of neutral formaline at the time of using the fixative.

Dr. Eichhorn adds Dionyle to any fixative whatever its composition may be.

In France this chemical is used as steeping agent in Dyeing Industry of wool and cotton in the proportion of 0·4 gm. per 100 c.c. of water. Dr. Eichhorn and Dr. Archambault use the same proportion for plant material. It is added to the fixative before the material is put for fixation or even afterwards. It is not necessary always to weigh it.

The Dionyle P. W. is very cheap and can be had from N. Boube 'e and Cie, 3 place St.-Andre-des-arts, Paris (VI). The price for 50 gms. is 4·50 francs and for 100 gms. is 8 francs, *i.e.*, Re. 0–14–0 and 1–10–0 respectively according to the present rate of exchange. It is better to keep it in glass-stoppered bottles.

R. K. SAKSENA.

Department of Botany,
University of Allahabad,
August 12, 1935.
At Present :—
C/o Prof. A. Guilliermond,
Memb. de l' Inst.,
12 Rue Cuvier, Paris, Ve.

[1] Archambault G., *Revue de cytologie et cytophysiologie Vegetales*, 1935, **1**, 173-174. (Published by Prof. Guilliermond, Paris.)

[2] Laugeron, M., *Precis de Microscopie*, *Masson, Paris*, 1934, pp. 342.

A Rare Instance of Change of Tropism in *Arachis Hypogœa*, Willd.

THE ovary of the groundnut flower, after fertilisation, develops a stalk or gynophore at its base. It elongates rapidly carrying the ovary at the apex which piercing the soil buries the ovary, where it develops into a pod. The structure of the gynophore is almost the same as that of the stem. But, peculiarly enough, while the stem is negatively geotropic, the gynophore is always positively geotropic. This tendency is shown very early even when the gynophore is just a few millimetres long. In 1932, the authors came across a unique specimen of a groundnut plant of A.H. 32—a Spanish Bunch variety, grown under dry conditions (Fig. 1) in which the "pegs" or gynophores exhibited different degrees of geotropism :—14 pods

developed normally and produced seeds; 7 gynophores were quite erect showing

Fig. 1.

Groundnut plant with negatively geotropic gynophores. E.P.—Erect peg. C.P.—Curved peg. × 1/4 Nat.

complete, negative geotropism; 4 gynophores after a period of normal downward growth began curving upwards, exhibiting change of tropism.

There was development of chlorophyll at the dilated and pointed apices, *i.e.*, the ovule-bearing portion of some of the abnormal pegs. One of these was quite green like a stem. The abnormal pegs did not produce normal pods and seeds.

With regard to the other morphological characters there was nothing unusual. The few normal seeds obtained from the abnormal plant were sown; but the offspring was quite normal and no peg showed either partial or complete negative geotropism. The chances for the occurrence of the abnormality seem to be very rare being less than one in a million, and no specimen other than the one mentioned could be found during the last three years.

With a view to explain the abnormality, a histological study was attempted. The epidermal cells at the tip of the normal gynophores (Fig. 2) are found to contain many round bodies—plastids. There are as many as 5–20 bodies in each of the cells at the tip. The number of the bodies gradually decreases away from the tip. They are round and 1 μ to 4 μ across. In specimens fixed in formalin-acetic alcohol, and stained with Haidenhain's hæmatoxylin, the plastids are

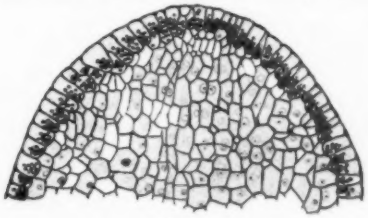


Fig. 2.

Longitudinal section of positive geotropic gynophore with numerous dark bodies in the epidermal cells. ×120.

seen as dark bodies almost filling the upper part of the cell cavity (in sections 10 μ thick) (Fig. 2). But in the abnormal pegs, the plastids are comparatively few or wanting (Fig. 3). When present they appear shrunken and much smaller than the normal.

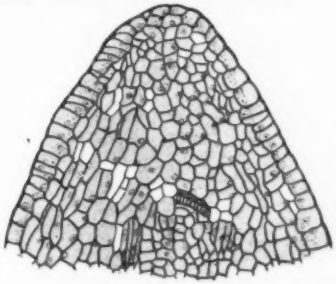


Fig. 3.

Longitudinal section of negatively geotropic gynophore with a few disintegrating bodies in the epidermal cells. ×120.

Waldron, R. A. (1919) while recognising the effect of gravity in bringing about the downward growth of the gynophore, considers that "the presence of definite granules in the lumen of each of the epidermal cells of the gynophore at the tip and their absence anywhere else suggest the possibility of such being the structures by which the organ perceives when it is out of line with gravity". He had, however, no opportunity to study the behaviour of negatively geotropic gynophores.

The effect of gravity alone is not the immediate, decisive factor in bringing about the downward growth or positive geotropic movement of the normal peg. Because in spite of gravity some of the pegs changed the direction of growth, there must be a cause more directly responsible. From the

abundance of the plastids in the normal pegs and their scantiness in the abnormal ones, it may be inferred that these bodies or the organs of perception that respond to gravity and bring about positive geotropic movement. The plastids appear first after fertilisation. If they are not formed at that time, the peg grows quite erect. In some pegs, the number and the size of the plastids get diminished, or they might disintegrate, after a period of normal growth; and then the peg curves upwards and becomes negatively geotropic. The function of the plastids is not analogous to that of the freely moving starch grains in certain grass roots, where they are said to bring about curvatures due to internal excitement set up by them (Statolith theory of geotropism). Unlike the starch grains, the plastids are confined to the upper part of the lumen of the cell. Their exact nature and the reason why after a period of normal functioning, they become affected and functionless, in certain rare instances, are not known; further study is expected to throw light on this very interesting subject.

The abnormal pegs did not produce any pods and seeds possibly for want of medium of sufficient resistance. In a set of experiments conducted in the Oil Seeds Section, the developing gynophores were made to enter artificially made up media. For this bamboo tubes about six inches long and about an inch in diameter and having a node septum at one end to act as bottom, were filled each with wet and dry, ordinary soil, stiff clay, sterilised sand, powdered wood charcoal, saw dust, cotton wool and also water separately. Empty tubes, dry and moist, were also set up. The tubes were buried in the soil to keep them in position and were covered with circular paraffined straw boards to make the tubes dark inside. Small perforations just to allow the passage of the gynophore were provided. Pods developed uniformly in the soil, clay and powdered charcoal irrespective of the medium being moist or dry; but pods did not form in the other media, *viz.*, saw dust, cotton wool and air, possibly for want of sufficient resistance.

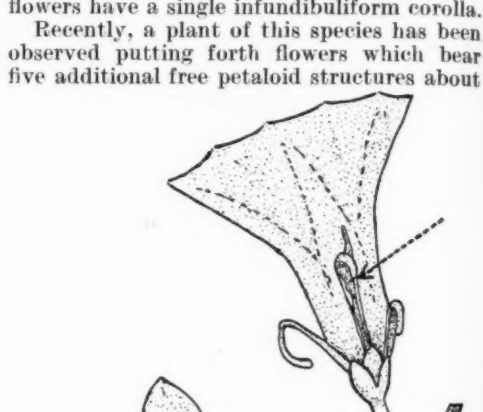
J. S. PATEL.
G. V. NARAYANA.

Oil Seeds Section,
Agricultural Research Institute,
Coimbatore,
June 7, 1935.

Duplicate Corolla in *Ipomœa palmata* Forsk.

Ipomœa palmata Forsk is a common garden convolvulus in Bombay. Ordinarily its flowers have a single infundibuliform corolla.

Recently, a plant of this species has been observed putting forth flowers which bear five additional free petaloid structures about



3 cm. long and 0·5 cm. broad, arising outside and jointly with the base of the corolla. The facing of this new whorl is inside out.

This additional development in a large number of flowers on a single plant is worth registering.

S. C. DIXIT.

Wilson College,
Bombay 7,
July 22, 1935.

Studies in the Development of the Pollen Grain and Embryo Sac of *Wolffia arrhiza*.

THIS interesting plant—the smallest angiosperm known—is seldom seen flowering. In November, 1933, the writer found it flowering abundantly near Agra. A study of the development of the gametophytes revealed several important differences from those of *Lemna minor* (Caldwell, 1899).[1]

Microsporogenesis and Male gametophyte.—The stamen, in early stages, consists of a very short filament and a spherical anther containing a mass of homogeneous cells

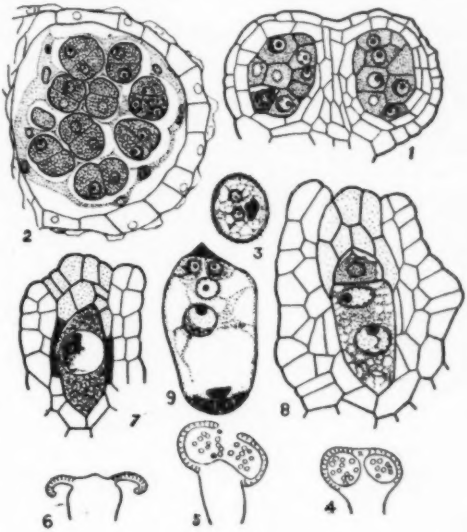
covered over by the epidermis. Soon a sterile plate of cells running vertically divides this mass into two so that by the time the peripheral archesporial cells cut off the primary parietal layer, the microspore mother-cells are seen in two distinct groups and the anther becomes bilobed in outline (Fig. 1). The primary parietal layer divides to form the endothecium and the tapetum (Fig. 1); there is no middle layer whatever. At maturity the cells of the endothecium enlarge and develop the usual fibrous thickenings while the epidermal cells degenerate and are sloughed off.

The tapetal cells, which remain only one-nucleate, become amœboid and project into the loculus (Fig. 2). The reduction divisions in the microspore mother-cells are successive, but a few cells lying towards the periphery do not undergo any divisions and degenerate.

In the pollen grain the generative nucleus is at first organised into a small lenticular cell separated from the large tube cell by a narrow space. Later, the generative nucleus becomes free though still surrounded by a cytoplasmic sheath. At this stage the periplasmodium is about to disappear completely and so is the sterile partition between the two lobes. The mature pollen grain is three-nucleate and the tube nucleus shows a degenerated appearance (Fig. 3).

The dehiscence of the anther is rather interesting. About the time when the pollen grains are 2-nucleate, the cells of the endothecium lying just over the sterile partition (at *x* in Fig. 4) presents a degenerated appearance and do not show the usual fibrous thickenings—these cells facilitate the opening of the anther (Fig. 5). At this stage the sterile plate of cells separating the two loculi also disappears and the two halves of the endothecial coverings curve outwards and downwards exposing the entire mass of pollen grains for dissemination (Fig. 6).

Megasporogenesis and Female gametophyte.—The nucellus in the early stages consists of only a few cells—the hypodermal archesporial cell usually surrounded by one layer of cells. This cell cuts off the primary parietal cell which undergoes one or two anticlinal divisions (Fig. 7). The megaspore mother-cell enlarges considerably destroying the whole of the nucellus except the two layers of cells at the top, so that the lateral sides of the subsequently formed embryo sac lie immediately adjacent to the inner integument. The megaspore mother-cell divides into two cells of which the upper degenerates while the lower, after 3 successive divisions of its nucleus, forms the normal eight-nucleate embryo sac (Figs. 8–9). Thus the development of the female gametophyte is of the "*Scilla type*" while in *Lemna*, Caldwell



FIGS. 1-9.

Figs. 1-9, showing the development of male and female gametophytes in *Wolffia arrhiza* Wimm Figs. 1-2 ×375. Figs. 4-6 ×43. Figs. 3, 7, 8, 9 ×630.

(1899) reported this to be of the "*Lilium type*". The antipodals are ephemeral and the polars fuse early (Fig. 9).

The ovule remains orthotropous throughout its development. Of the two integuments, the outer begins to develop only after the megaspore mother-cell has undergone one division. The carpel shows a clear stylar canal extending throughout its length. Further investigation on the development of the endosperm and embryo is in progress.

I am greatly indebted to Dr. P. Maheshwari for his kind help and valuable suggestions.

B. L. GUPTA.

Department of Botany,
Agra College,
Agra, India,
March 29, 1935.

[1] Caldwell, O. W., "On the life history of *Lemna minor*," *Bot. Gaz.*, **1899, 27,** 37-66.

A Note on the Chromosome Numbers of Some Eleusine Species.

N. S. RAU[1] (1929) considered 36 as the probable diploid number in the root-tips of *E. coracana* Gaertn. Avdulov[2] (1931) has determined 18 and 36 to be the diploid numbers in Eleusine and suggests 9 or 10 to be the basic number of the tribe *chlorideæ*. Hunter[3] (1934) confirms the number 36 for *E. coracana* obtained by Avdulov.

The present investigation was taken up to determine the chromosome numbers in some of the local Eleusines. The following species, collected at Coimbatore, were studied :—*E. coracana*, Gaertn. ; *E. indica*, Gaertn. ; *E. brevifolia*, Br. ; *E. ægyptiaca*, Desf. Flower buds were killed between 10-11 A.M. in the following fixatives: Carnoy's, Allan's modification of Bouin's and Flemming's (weak). Sections were cut at 10-12 μ and stained in hæmatoxylin and also gentian violet iodine.

The haploid chromosome numbers were determined in metaphase plates and at diakinesis as follows :—*E. indica*—9 ; *E. coracana*—18 ; *E. brevifolia*—18 ; and *E. ægyptiaca*—17. Secondary pairing was noticed in the last three species. It is evident that *E. indica* is a diploid, *E. coracana* and *brevifolia* are tetraploids, while *E. ægyptiaca* is probably a tetraploid with one pair lost ($4x-2$). The basic number is, obviously, 9.

N. KRISHNASWAMI.
G. N. RANGASWAMI AYYANGAR.
Millets Breeding Station,
Coimbatore,
June 14, 1935.

[1] Rau, N. S., *Indian Jour. Bot.*, 1929, **8**, 126.
[2] Avdulov, N. P., *Bull. Appl. Bot. Genet. & Plt. Breeding*, 1931, **43**, 428 ; *Eng. Trasl. Summary Imp. Bur. Plt. Genet. School of Agric.*, 633, 1 ; **576**, 312 ; **576**, 16.
[3] Hunter, A. W. S., *Canadian Jour. Research*, 1934, **11**, 213.

Two New Host-Plants of *Loranthus* at Allahabad.

THE partial parasite *Loranthus* commonly grows in the Upper Gangetic plain on a number of host-plants belonging to different families of the Dicotyledoneæ. They are especially found on trees or shrubs, the commonest hosts being *Mangifera indica* and *Bassia latifolia* (Duthie,[1] Brandis[2]).

In January 1935, the author observed this parasite growing on a guava (*Psidium Guayava*) tree, which was an unfamiliar sight. No other plant in the vicinity, but a number of guava trees in an orchard about 2 miles off, had *Loranthus* on them. On looking up the literature on the subject,

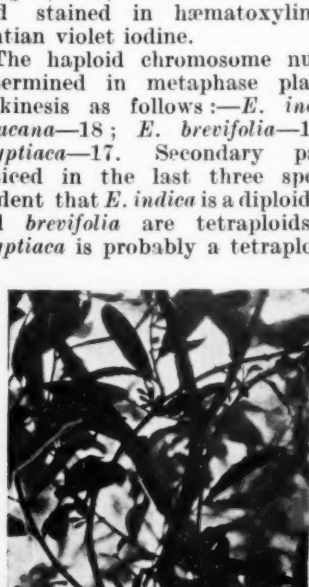


Fig. 1. *Loranthus longiflorus* on *Psidium Guayava*.

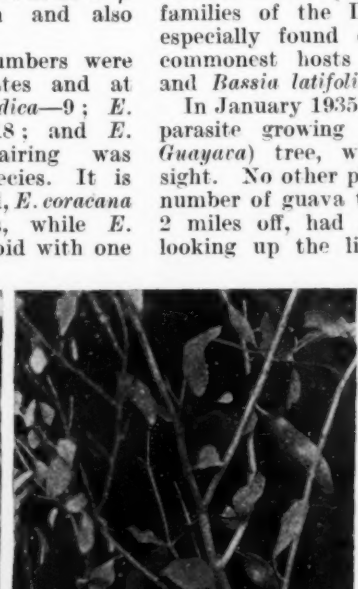


Fig. 2. *Loranthus* sp. on *Citrus medica* var. *acida*.

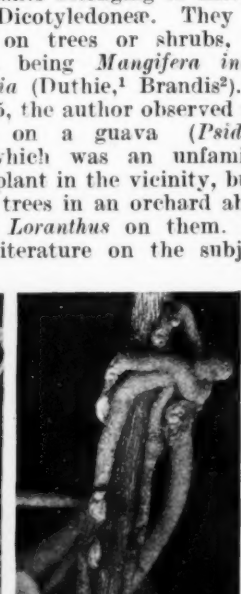


Fig. 3. The same as Fig. 2. showing the secondary roots and haustoria of the parasite.

no mention of *Psidium Guayava* as a host of *Loranthus longiflorus* was found.

A knob was, as usual, formed at the junction of the parasite and the host (Fig. 1). The parasite produced a number of branches with glabrous and somewhat leathery leaves. Flowers and fruits were present. The parasite was *Loranthus longiflorus* Desr. which is the commonest species in the United Provinces.

Psidium Guayava is a non-indigenous plant of the family Myrtaceæ with bark composed of dry membranous layers but now it is naturalised throughout India (Hooker[3]).

Scott[4] and Bidie[5] are of opinion that plants having deciduous bark with dry membranous layers are unfavourable hosts of this parasite.

Fischer[6] dissents from the above view and has mentioned in his list, a number of plants attacked regularly by the parasite, which have similar characters of the bark, but very few plants of the family Myrtaceæ, especially the non-indigenous genera, are recorded by him as host-plants.

Patwardhan[7] noted *Eucalyptus rostra*, a non-indigenous plant as a host of *Loranthus longiflorus* in Poona. Kamerling[8] mentions *Loranthus dichrous*, a species not found in India, on *Psidium Guayava* in Brazil.

Later on, sometime in the middle of February, the parasite was seen growing on another new host-plant, *viz.*, *Citrus medica* var. *acida* (Fig. 2). The primary root was not seen at that stage. A number of secondary roots were seen arising at the point of infection which was the junction of the host and parasite. A knob-like structure was formed at this point. These roots grew outwards and spread over the surface of the host-plant, coiling round in every direction and sending out the haustoria into the tissues of the host to absorb the necessary nourishment (Fig. 3). The roots vary in size and length with age. Some of these were fairly thick and brown with a number of lenticles on them, others were thin and green in colour, with conical growing tips. From these spreading roots, erect branches bearing a number of foliage leaves were developed. By means of these secondary roots the infection is spread over the surface of the host-plant. These roots were not sensitive to gravity as they seemed to be going up or down the branch indiscriminately. The bark of the host-plant was fairly thick.

Fischer[6] in his list mentions *Citrus medica* as a host for *Loranthus neelgherrensis* and another species (not named) of *Citrus* attacked by *Loranthus elasticus* in Southern India. Both of these species of the parasite are not found in Northern India.

I am to express my great indebtedness and sincere thanks to Prof. J. H. Mitter for his kind suggestion and advice. Thanks are also due to Mr. Anil Mitra, for preparing photographs.

G. D. SRIVASTAVA.

Department of Botany,
University of Allahabad,
August 12, 1935.

[1] Duthie, J. F., *Flora of the Upper Gangetic Plain*, 1915.
[2] Brandis, D., *Indian Trees*, 1907.
[3] Hooker, J. D., *Flora of British India*, 1897.
[4] Scott, G. J., *J. Agri. and Hort. Soc. of India*, 1817, **2**, Part I.
[5] Bidie, *Report on the Nilgiri loranthaceous parasitical plants destructive to forest and fruit trees*, 1874.
[6] Fischer, C. E. C., *Rec. Bot. Survey of India*, 1926, **11**, No. 1.
[7] Patwardhan, C. B., *J. Indian Bot. Soc.*, 1924, 25, **4**.
[8] Kamerling, Z., *Ber. deutsch. bot. Ges.*, 1914, **32**, 17 (quoted in MacGregor Skene—*The Biology of Flowering Plants*, 1924, 228).

A Note on a Comparative Study of the Chromosomes in Ten Species of Indian Dragonflies.

LEFEVRE AND MCGILL[1] as co-workers (1908), Smith[2] (1916) and Oguma[3] (1930) are the only authors who so far have devoted their attention to the chromosome studies in this very ancient family of insects. In a paper published by Oguma and Asana[1] (1932) attention was drawn to a very interesting observation, whose significance is not yet quite clear, that the so-called *m*-chromosome (the smallest among the autosomes) presents every grade of size reduction among the testicular cells of a single individual belonging to a species of *Odonata*, *Tramea chinensis*, collected in the vicinity of the Gujarat College, Ahmedabad, Western India.

This rather remarkable observation led us to make a comparative study of the chromosomes in the male germ cells of some ten species of Indian dragonflies so far collected, from a very restricted area situated in the neighbourhood of the Ismail College, Jogeshwari, about 20 miles north of Bombay. The following observations are based on the species listed below.

May we take this opportunity to express our thanks to Colonel F. C. Frazer who very

kindly identified the species for us. A short account of our observations on the chromosome numbers, the X-chromosome and the *m*-chromosome of these Indian species of dragonflies is given below:

Species	Haploid	Diploid
Sub-Order Anisoptera		
Sub-family Libelluniæ		
1. *Pantala flavescens* ..	13	25
2. *Tramea limbata*	13	25
3. *Trithemis palladinervis* ..	13	25
4. *Diplacodes trivialis* ..	13	25
5. *Brachythemis contaminata* ..	13	25
6. *Crocothemis servilia* ..	13	25
7. *Potamarcha obscura* ..	13	25
8. *Orthetrum sabina*	13	25
Aeschininæ		
9. *Ictinus rapax*	12	23
Sub-Order Zygoptera		
Family Coenagrionidæ		
10. *Ceriagrion rubiæ*	14	27

As will be seen from the above table, all the members of Libelluniæ show a constancy in the number of chromosomes, 25 in diploid and 13 in haploid. In *Ictinus* which belongs to another group, Aeschininæ, the diploid is 23, the haploid 12. The chromosome number in *Ceriagrion* (Coenagrionidæ), whose chromosomes have been studied for the first time, the number is the largest among all the dragonflies studied so far.

Despite the variation in the chromosome number, there is present an unpaired X-chromosome, without exception, in all the species investigated. In every case, the X-chromosome always takes a peripheral position on the outer circle of the spindle both in the spermatogonial and primary spermatocyte metaphases and acquires a peculiar eccentric position in the metaphase of the secondary spermatocyte. And a special emphasis may be laid on the fact that it separates into two equal halves in the primary spermatocyte division, but migrates to one pole entire without separation, ahead of other chromosomes, in the second spermatocyte division.

However, regarding its size or magnitude in relation to other chromosomes it does not show a uniform behaviour in all the ten species studied. Taking first all the species of Libelluniæ, the X-chromosome in all of them looks nearly, though not exactly, equal in magnitude to the second smallest autosome univalent in the spermatogonial complex. While in *Ictinus rapax* (Aeschininæ), it is interesting to note, the X-chromosome stands as the largest element in its chromosomal complex. It is remarkably large and occupies a central position in the spermatogonial metaphase. In *Ceriagrion rubiæ*, a representative of our third group, Coenagrionidæ, the X-element, in its size relation to other members of the complex, resembles the X-chromosome in the species of Libelluniæ.

Finally, throughout all these Indian species of dragonflies the smallest autosome, the so-called *m*-chromosome, is present without exception. And it is a remarkable fact that the relative magnitude of this *m*-chromosome to that of the X-element varies from species to species.

A full account of these observations will be published elsewhere.

J. J. ASANA.
S. MAKINO.

Gujarat College,
Ahmedabad, India.
and
Hokaido Imperial University,
Japan.
July 26, 1935.

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[2] Smith, E. A., "Spermatogenesis of the dragonfly, *Sympetrum semicinctum* (Say) with remarks upon *Libellula basalis*," *Biol. Bull.*, 1916, **31**.

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Madras Fisheries Department.

TWO serious misapprehensions on the part of the reviewer of my report on the Madras Fisheries Department for 1933–34 in the June number of the *Current Science* call for remarks:—

Hilsa.—The reviewer states, "The Department's efforts to introduce *Hilsa* along the west coast are not likely to meet with success as there are no large rivers in that area for fish to run up for spawning purposes." There is nothing in the report to lead the reviewer to believe that the Department is making such efforts. More than 25 years ago the late Mr. Wilson made a solitary experiment of planting some *Hilsa* eggs in the Ponnani river. This was never repeated as the unsuitable nature of the west coast

rivers for the breeding of *Hilsa* was recognised years ago by the Department.

Catla.—Regarding the introduction of *Catla* in the Cauvery the reviewer has misunderstood the scope and aim of the Department's operations. He remarks as follows: "It is doubtful, however, whether any good can result from the stocking of the upper waters of the Cauvery because the fish is not adapted to live in clear rapid running water." The "upper reaches" referred to is the section of the Cauvery river above the Mettur Dam up to the Hoginkal falls (now the Mettur reservoir) and the reach immediately below the Dam. The reviewer is wrong in assuming that *Catla*—which is "a tank fish" in the sense that it enters tanks for feeding and growth—does not live in rivers. Our studies of the habits of *Catla* as well as experience in its culture in South India for the last 20 years prove beyond doubt that *Catla* will not breed in the stagnant water of tanks and ponds like some other carp though they grow and thrive in them, but require a river or stream of running water for breeding. The experience of culturists elsewhere in India has been the same. A striking evidence of this—if proof is needed—is found in the occurrence of *Catla* in the Cuddapah and Nellore Districts, only where the tanks and rivers (the Pennar river system) are directly connected by the Cuddapah-Kurnool canal with the upper waters of the Kistna (Tungabhadra) in this Presidency. Soon after this canal was opened, *Catla* began to appear in the Pennar river and connected tanks in the Cuddapah and Nellore Districts where it was unknown before.

The reviewer may rest assured that the Madras Fisheries Department does pay some regard to the ecology of fish that are subjected to artificial cultivation.

B. SUNDARA RAJ.

Madras Fisheries Bureau,
July 11, 1935.

IN the above note attention is drawn to two supposed "serious misrepresentations" on my part. In my review I represented the Madras Fisheries Department as making efforts to introduce *Hilsa* along the west coast and of stocking the clear rapid-running waters of the Cauvery with *Catla*. At the very outset, it may be stated that I had no intention of running down the work of the Madras Fisheries Department or of minimising the splendid efforts that are being made in that province in connection with the improvement of fisheries.

The title of my review—"Madras Fisheries Department"—is partly suggestive of the scope of my remarks. For the purpose of an adequate review of the last report of the Department, I read several earlier reports and the impressions I gained from this study are embodied in my comments on the work of the Department. In order to follow my remarks about *Hilsa* and *Catla*, the readers are, therefore, advised to study the relevant parts of the earlier reports of the Department as well.

It is a great relief to learn now for the first time that the experiments started by the Department about the introduction of *Hilsa* along the west coast are not being repeated. Regarding *Catla*, however, the position is somewhat different. In the report for 1930–31 (para. 144, p. 44) it is stated that "*Catla* has been stocked in upper waters of the Cauvery first below the Hoginkal falls and later at Mettur above the dam." My submission is that pools below waterfalls are not suitable for stocking fishes of the *Catla* type, which is essentially a fish of sluggish waters, such as ponds, tanks, large rivers, etc. Moreover, the description of the stream below the falls shows that it consists of rapids, and, if this is really so, the fish has no chance to live and flourish as *Catla* is not adapted for life in swift currents. My assumption is borne out by the results obtained by the Madras Fisheries Department which has been stocking with *Catla* the Cauvery below the falls for a period of several years but has not obtained any definite proof so far that the fish has established itself in these waters. With the formation of the "Mettur reservoir" the results may be different.

What is stated in the above note regarding the ecology and bionomics of *Catla* is elementary knowledge for people of northern India. *Catla* breeds during monsoon floods when it gets an opportunity to leave its permanent abode and enters shallow, warm waters of paddy fields, etc. So far as my information goes, it does not breed in rivers but in the flooded country adjoining them.

REVIEWER OF THE REPORT.

Dairy Science.*

MILK is the most important food of man and beast and in the early stages of their life, offers the only source of nutriment ensuring steady maintenance and growth, building up immunity against disease and laying the foundations of the future health of the individual. The constituents of milk, proteins, sugars, fats, pigments and minerals are so well-proportioned as to render this product one of the most easily digestible and highly assimilable of all foods. These unique properties and its indispensability in the nutrition of animals, have been responsible for stimulating a vast amount of research on the physical, colloidal, chemical, bacteriological and nutritional aspects of milk.

The recent publication entitled *Fundamentals of Dairy Science*, is devoted to a discussion of these fundamental questions and provides detailed and authoritative information on these various aspects from a purely scientific point of view.

The first five chapters deal with the chemical composition of milk and milk products, and proteins, fat and carbohydrates comprising the essential constituents of milk. An entire chapter has been devoted to an able review on the pigments of milk which have assumed great importance in relation to vitamins and respiratory enzymes.

Milk furnishes one of the finest examples of a typical and perhaps a comprehensive colloid, several phases of varying degrees of dispersion, participating in the system. A beautiful discussion of this colloidal aspect is to be found in the chapter on the physical equilibria of milk. The sizes of particles which were wrongly expressed in the previous edition have now been corrected and the conventional and generally accepted unit, $m\mu$, adopted.

Many of the physical and chemical properties of milk, which are of great importance from an industrial point of view, have been discussed in relation to certain processes in the dairy industry. The creaming ability of milk has been correlated with the state of aggregation of the fat globules and the effect of several industrial treatments like pasteurisation, homogenisation, etc., on creaming has been discussed from the fundamental standpoint. In a similar manner, the quality of foaming, cream-whipping and coagulation in relation to cheese manufacture, which is one of the most important of dairy industries, have been treated.

Milk is an excellent culture medium for the growth of various types of micro-organisms including many bacteria pathogenic to man, and the large-scale production, handling and transportation of such a product, therefore, present problems in pasteurisation, maintenance of sterility etc., involving a rigorous bacteriological control, which is facilitated by a close understanding of the ecology of the bacterial associates, their multiplication and growth in relation to the physical and chemical properties of milk. These problems are presented in the series of chapters devoted to a discussion of the microbiology of milk and milk products.

The last two chapters provide information of great interest not only to the physiological chemist but also to the general reader. The nutritional value of milk in the early and later stages of the life of an animal, is discussed in relation to other sources of nutriment. Attention is drawn to the incidence of nutritional anæmia due to the low content of iron and copper in milk, constituents found essential for the regeneration of hæmoglobin. Vitamin constituents of milk in relation to breeds and feeds are discussed.

The rôle of colostrum in the nutrition and immunisation of infants and young ones has been the subject of controversy and a useful discussion of this vital subject which is presented in the volume is helpful to those investigators interested in this aspect of milk nutrition.

Most of the valuable information contained in the volume relates naturally to cow's milk which is the most important dairy animal in the world; but there are other animals like the buffalo and the goat which are the main, if not exclusive, sources of milk to certain races and communities. Buffalo's milk in particular deserves a more detailed treatment since it is often a more economical dairy animal yielding a richer quality and larger quantity of milk. Data giving a comparative idea of the nutritive values of milks from various milch animals would form a most useful addition to this chapter on the nutritional value of milk.

This monograph is perhaps the only treatise in the English language which deals in a comprehensive manner with the several aspects of dairy science. It is a volume

* *Fundamentals of Dairy Science*, by Associates of ore A. Rogers, Reinhold Publishing Corporation, New York, Second Edition, 1935, pp. 616, $ 6.

which will be gratefully welcomed not only by a number of specialist investigators, the colloid chemist, the biochemist, the physiologist and the bacteriologist, but also by dairy technologists, physicians and food-chemists, interested in the relation of milk to public health and nutrition.

(MISS) K. BHAGVAT.
M. SREENIVASAYA.

The Arachnida.*

SINCE Warburton's article in the *Cambridge Natural History* which appeared as far back as in 1909, no complete account of Arachnida in the English language existed and the present monograph fills a gap in our knowledge of Arthropods.

In the prolegomena considerations like the general characteristics, habits and behaviour and the evolution and classification of the class have been dealt with. Our knowledge regarding many of these problems is by no means complete, but the author, including most of the recent literature on the subject, has made it as up-to-date as possible. Buxton's extensive researches on the coxal glands of arachnids and Millot's investigations into the anatomy and physiology of many arachnids have been incorporated. A consideration of the evolution of the class is not a matter of ease. Conflicting theories like those of Ray Lankester and Pocock, of Zittel and of Leukart, Hansen and Sorensen have made the problem a very difficult tangle from which only a few very clear features emerge. The Trilobita, the Eurypterida and Limulus centre round this problem, and the question ultimately resolves itself to a matter of assigning importance to the fossil remains of the Eurypterida and the Trilobita, and the few forms that stand intermediate between these and Limulus. It need hardly be emphasised that the ancestry of arachnids is closely bound up with the question of the primitive habitat of arachnids and there is no doubt that, should the theory of Leukart, Hansen and Sorensen come to be accepted, there should have to be a complete change in the interpretation of the diverse characters presented by the arachnids. But it is more likely that, if there is one group of animals that will shed more light on this vexed question, it is the Onychophora.

Nor has the classification of the Arachnida been free from changes and this is mainly due to the indiscriminate distribution of many anatomical features among the different orders. The Arachnida, therefore, cannot be divided into orders which can be arranged in an ascending series. A number of schemes of classification have been examined by the author who finally adopts Pocock's scheme, with this alteration, that he excludes the Trilobita from the Arachnida on the ground that they are primitive Crustacea.

The Xiphosura has been treated with a thoroughness which it richly deserves. The only group of primitive arachnids which is surviving to this day, it also includes the only marine forms. A chapter is devoted to each of the other orders, whose anatomy, distribution, classification and diagnostic features are described. Of these the Recinulei stand out with great prominence. This group of arachnids whose rarity is great and whose importance is hardly less, seems to be the only one where the animals possess no type of sense organ and carry their genitalia in their tarsi. Only 32 living specimens are known and as the author says "the future of this group may well hold surprises in store".

Two chapters are devoted to extinct arachnids, of which the Eurypterida are the most important. The position of the Trilobita is also discussed, the author being definitely of opinion that they are primitive Crustacea.

Our knowledge of the Pycnogonida, Tardigrada and Linguatelida has not advanced further after the article by Warburton in the *Cambridge Natural History* and even in 1935 the author of a treatise on Arachnida has to treat them as "doubtful arachnids". The Tardigrada have the least justification for inclusion amongst the arachnids.

But for Mr. Savory's long chapter on economic arachnology, one would have thought that these animals were of no economic importance. He has given a variety of ways in which the Arachnida influence the lives of men. The ticks and mites, the spiders

* *The Arachnida.* By Theodore H. Savory. Pp. xi+218, 8 Plates. (London: Edward Arnold & Co. 1935.) 25 *sh.* net.

and scorpions and even Limulus seem to contribute to this importance.

In a work on the Arachnida and for that matter, on any Arthropod class it is impossible to avoid extensive classification and the monotony of this has been successfully dispelled by the "excursus" which the author appends to every chapter. Many of these are full of interest to the layman, and all to the naturalist. In one, on "The Arachnida as formidable animals" (page 113), the author discusses the psychology of fear and accounts for the terror that spiders and scorpions infuse in our minds as due to the rapid movements that these animals exhibit. While granting that rapidity of movement is one of the contributory causes of fear, it should be said that it is only one of the causes. Nor is it a reason in all cases of fear. A swiftly darting bird does not infuse terror and after all, a dead scorpion induces fear just as much as a moving, very much alive one. Several other topics of general interest are dealt with in these little essays and the book closes with a full bibliography and a complete index.

B. R. S.

Functions and Organisation of the India Meteorological Department.*

IN an interesting pamphlet entitled "Functions and Organisation of the India Meteorological Department, 1935," the Meteorological Office, Poona, has summarised the various functions of the Department and has described briefly the organisation that exists at present for carrying on these duties. The list is comprehensive and contains all the important phases of the work usually dealt with by similar institutions in other progressive countries. Increasing attention has, of late, been given to the problems of upper air, chiefly owing to their importance in connection with aviation; but it is admitted that the meteorological service for this purpose still falls short of the minimum recommended by the International Convention.

Besides meteorology, the activities of the Department include some branches of allied sciences such as seismology and terrestrial magnetism. Thus geophysical researches form part of the routine duties at the Colaba and Alibag Observatories while the Observatory at Kodaikanal, South India, specialises in the study of solar physics and has undertaken some work in co-operation with the International Astronomical Union. Mention is made also of the seismographs that have been maintained at a few stations for the systematic recording of earthquakes.

It is interesting to note that a section for agricultural meteorology has been recently established at the headquarters of the Department, at the Instance of the Imperial Council of Agricultural research. Besides statistical investigations, the section makes a special study of microclimatology and generally carries on researches on problems affecting the welfare of the crops. In view of the supreme importance of this branch of the subject to an agricultural country like India the results of these investigations will ultimately prove to be of considerable practical value. A brief outline is also given of some features of the developments that are contemplated as soon as financial conditions permit; and the note concludes with four appendices giving extracts relating to meteorology from the proceedings of International Conventions and the Royal Commission on Agriculture in India.

* Functions and Organisation of the India Meteorological Department. 1935. Meteorological Office, Poona.

The Indore Meeting of the Science Congress.

ARRANGEMENTS are now actively in hand for the forthcoming meeting of the Indian Science Congress Association in Indore. As usual, the date of the meeting is from the 2nd to the 8th of January, 1935, thus enabling members to avail themselves of the Christmas concession on the railways. In addition, the railway authorities have been approached with regard to granting further concessions, but their decision in the matter will not be known until after the Railway Association has met at Simla in October.

The meeting is being held under the patronage of H. H. Maharajadhiraj Raj Rajeshwar Sawai Shree Yeshwant Rao Holkar Bahadur, Maharaja of Indore. In accordance with the alteration which was made last year in regard to the President's term of office, Dr. J. H. Hutton will remain President of the Association until he hands over his office at the Inaugural Meeting to the President-Elect, who is Rai Sir Upendranath Brahmachari, Bahadur, Kt., M.A., M.D., Ph.D., F.S.M.F., F.A.S.B.

At the last meeting of the Congress, held in Calcutta, two alterations were made in the list of Sections. The name of the Geology Section was changed to "Geology and Geography," thus indicating that papers on geography would be accepted; while a new section for Physiology was added, thus bringing the number of Sections upto 10.

The names and addresses of the Sectional Presidents are as follows:—

1. *Mathematics and Physics.*—Dr. T. Royds, D.Sc., Director, Kodaikanal Observatory, Kodaikanal, S. India.

2. *Chemistry.*—Dr. P. C. Guha, D.Sc., Professor of Organic Chemistry, Indian Institute of Science, Bangalore.
3. *Geology and Geography.*—B. Rama Rao, Esq., M.A., Mysore Geological Department, Bangalore.
4. *Botany.*—Dr. S. R. Bose, D.Sc., F.R.S.E., F.L.S., Professor of Botany, Carmichael Medical College, Belgachia, Calcutta.
5. *Zoology.*—Dr. H. K. Mukherjee, D.Sc., D.I.C., University Professor and Head of the Department of Zoology, Calcutta University, 35, Ballygunge Circular Road, Calcutta.
6. *Anthropology.*—H. C. Chakladar, Esq., M.A., Lecturer in Anthropology, Calcutta University, 28-4, Srimohan Lane, Kalighat, Calcutta.
7. *Agriculture.*—Mr. A. K. Yegna Narayan Aiyer, M.A., Dip. in Agri. (Cantab.), N.D.D., F.C.S., Retired Director of Agriculture, Sankarapuram, Bangalore.
8. *Medical and Veterinary Research.*—Lt.-Col. H. E. Shortt, I.M.S., Director, King Institute, Guindy, Madras.
9. *Physiology.*—Dr. W. Burridge, D.M., M.A. (Oxon.), Professor of Physiology, University of Lucknow, Lucknow.
10. *Psychology.*—J. M. Sen, Esq., M.Ed. (Leeds), B.Sc. (Cal.), F.R.G.S., Inspector of Schools, Presidency Division, Bengal, 63, Lansdowne Road, Calcutta.

Papers should be submitted to the Sectional Presidents concerned by the 15th of September. A little extra time will be allowed to contributors in the Punjab.

One of the primary purposes of the Association is to encourage scientific work in different parts of India. This year it is meeting in Indore for the first time, and it is hoped that a large number of members will attend and help to stimulate scientific research in that part of India.

Indore, in addition to being fairly centrally situated for scientists from Western and North-western India, offers many attractions both in the City itself and in its immediate neighbourhood. Owing its origin to the great movement for Mahratta imperialist expansion of the 18th century, Indore at present enjoys the premier position among the States included in the Central India Agency.

The City of Indore is situated 1,738 feet above the sea-level and has a delightful climate and moderate rainfall. It ranks amongst the great industrial towns of India, having flourishing cotton-mills and an expanding population now estimated at about 1,50,000 people. It is an important educational centre, containing two first-grade colleges (one of which is maintained by the State), a number of high schools for boys and girls and other institutions. In the Civil Area are situated the Daly College (an institution for the sons of Chiefs), which is a fine building of white marble, the Plant Institute, and a Medical School. Indore also contains many places and buildings worth seeing. A few miles from the City is Badarkha, where up-to-date water works (with the largest siphon system in the world) are nearing completion.

About 60 miles from Indore and situated in Dhar State is Mandu, a favourite haunt of tourists and students of India's past history. Once the proud capital of the independent Muslim kingdom of Malwa and a fort of unparalleled natural strength, it now contains extensive ruins of mosques, palaces and other buildings of great architectural merit. Not far off from it is Bagh (in Gwalior State), which is famous for its rock-cut caves of great antiquity. About forty miles to the south of Indore is Mandhata, an island of superb natural beauty in the Nerbudda river, the early capital of Indore State, which contains a palace and a marble statue of the saintly Ahilya Bai, one of the most illustrious rulers of the State and of India. Not very far off from Indore and easily connected by railway are Ujjain, one of the most ancient and sacred cities of India, Sanchi (in Bhopal State) with its famous stupa supposed to date from the time of the great Asoka, Chitore the most historic place in Rajputana, and the world-celebrated Ajanta caves.

The Local Secretaries will be Dr. S. S. Deshpande, Vice-Principal and Professor of Chemistry, Holkar College, Indore, and Mr. K. A. Patwardhan, Daly College, Indore, to whom all enquiries as to accommodation should be addressed. It is particularly requested that very early intimation of the accommodation required should be sent to the Local Secretaries.

W. D. WEST.

Sir Richard Arman Gregory, Bt., F.R.S. and Dr. Arnold Berliner, Dr.Phil.

WE are glad to announce that Sir Richard Gregory and Dr. Arnold Berliner have accepted our invitation to act as Associate Editors of *Current Science*, and we have no doubt that this news will give widespread satisfaction among those interested in the progress of the Journal.

We have had the privilege of meeting Sir Richard and Lady Gregory during their visit to this country in January and February of 1933 and of discussing with him about the affairs connected with *Current Science*. We need hardly say that we are deeply indebted to him for the numerous suggestions which he offered at the time, and since his return to England, he has maintained his interest in this Journal.

Dr. Arnold Berliner has not visited India but we hope that he will be able to come over at an early date and spend a pleasant time among his numerous friends in this country. We would be glad to offer welcome to him on behalf of our numerous readers and there will always be generous hospitality for him in this country.

The service which Sir Richard Gregory and Dr. Arnold Berliner are rendering to the cause of Science is indeed conspicuous. Their association with their respective Journals during the past thirty years or more has rendered the publications unique. To every Scientist *Nature* and *Naturwissenschaften* are as familiar and indispensable as the objects by which they are surrounded in their Laboratory. Their knowledge and experience will be of great assistance to us in shaping the destiny of *Current Science* and when this assistance is coupled with the advice and co-operation for which we are always indebted to the members of the Board of Co-operators, *Current Science* is bound to become the Indian counterpart of *Nature* and *Naturwissenschaften*,

Research Notes.

Effect of Simultaneous Electric and Magnetic Fields on Spectral Lines. I. Crossed Fields.

A STUDY of the effect of magnetic fields (Zeeman Effect) and of electric fields (Stark Effect) has been a guiding adjunct in the classification of spectral lines and the theoretical investigations of these effects have been of fundamental importance in the development of Quantum Principles. The simultaneous effect of magnetic and electric fields on spectral lines has now been investigated by W. Steubing and the results are reported in the *Sitzb. d. Preuss. Akad. d. Wiss. Berlin*, 1935, p. 3. We shall here summarise the effect observed when the magnetic and electric fields are perpendicular to each other. In every case the pattern due to the electric field is altered by the introduction of the magnetic field. The following regularities have been observed :

(*a*) The *p*-components of the electric field are affected.

(*b*) Such series lines as have a large Stark effect are very sensitive to the magnetic field while those that show small Stark splitting exhibit only a Zeeman effect. However, the separation produced is sometimes larger and sometimes smaller than that due to the normal Zeeman effect. The variation from one series to another is more than double for the same electric and magnetic fields.

(*c*) The lines of the sharp series, so far at least as the first members are concerned, separate as in the pure Zeeman effect, apart from an alteration in the intensities of the components. Similarly the lines due to forbidden combinations which appear under the electric field show only the Zeeman effect. The effect on the principal series is intermediate between that on the sharp series and the effect observed in the diffuse series.

(*d*) In the case of the diffuse series, the number of components produced by the electric field remains unaltered, but the lines broaden out asymmetrically, so that those on the longer wavelength side widen towards the red while the lines on the shorter wavelength side broaden towards the violet. These widened bands have no structure. The bands have a sharp edge on one side and trail off on the other side and have a width about five times the maximum Zeeman separation of the same line.

(*e*) Both in the diffuse series and in the principal series, the broadening increases with the total quantum number. The inner components are less broadened than the outer.

(*f*) The crossing of the fields does not give rise to any new lines.

(*g*) The effect of a magnetic field below 10,000 oersteds is small, but above 20,000 oersteds its effect is more marked than that due to an electric field of 100,000 volts per centimetre.

T. S. S.

The Ferromagnetism of Gadolinium.

THE only known ferromagnetic elements were until recently iron, nickel and cobalt but now another has been added to the family thanks to the labours of G. Urbain, P. Weiss and F. Trombe (*Comptes Rendus*, 1935, **200**, 2132). This new member of the ferromagnetic group is the rare earth metal Gadolinium recently isolated in great purity by F. Trombe. The only impurities were 0·7% of silicon and 0·03% of iron. Small quantities of this precious metal had to be employed and the methods developed at Strasbourg for handling quantities of the order of 0·12 grm. were found most serviceable. Gadolinium was found to be even more ferromagnetic than iron but only at low temperatures. Its Curie point above which the ferromagnetic character is lost happens to be $16° \pm 2°$ C. so that it is only at low temperatures that its ferromagnetic character would be displayed. The specific magnetisation σ varies with the field according to the equation $\sigma_H = \sigma_\infty (1 - a/H)$ and its behaviour from the boiling point of liquid nitrogen, *viz.*, 77° K. to the Curie point shows its great magnetic reluctance, for the constant a in the above equation has the value 1250 while for iron it is below 10. At 77° K., however, its specific magnetisation reaches a larger value than that for iron beyond about 15000 gausses. The absolute saturation value calculated from a T^2-law which is found to hold even below 77° K. comes out to be 253·5 C.G.S. units while for iron it is 221·7. The atomic moment of Gadolinium is 35·4 Weiss magnetons while it is only 11 Weiss magnetons in the case of iron.

T. S. S.

The Growth of Crystals.

ALTHOUGH a considerable amount of information has been accumulated on the nature and constitution of crystalline materials, not much is known about their actual mode of formation and other details regarding their growth. An interesting and convenient method of studying the evolution of crystals is to follow the changes in the interference colours of thin crystals. Preliminary observations have been made on these lines by Perrin, Marcelin and others, who found among other things, that the increase in thickness is a discontinuous process, the smallest step being of molecular dimensions. L. Kowarski has taken up a further detailed examination of this interesting subject, and the first qualitative studies on the formation and growth of *p*-toluidine crystals by controlled sublimation, are reported in *J. de Chimie Physique*, 1935, **32**, 303. According to the state of the support, a razor blade, the sublimed crystals may be single, of uniform thickness, and possessing freely curved contours (curved region); or else, they may be in groups and aggregates in each of which there is a fixed orientation and stratification (oriented region). In this region, the appearance of the crystals is very complex, and the growth is particularly active in regions of recent formation (buds). On rapid heating small drops of liquid appear on the crystal surfaces. A number of phenomena indicate a reciprocal relationship between the movement of these drops and the intensity of crystal growth.

Metallic Membranes.

FOR the study of permeability and membrane equilibria, collodion membranes possess many valuable properties, but have the characteristic of taking up only a negative charge in aqueous solutions. It is however frequently desired to have a positive charge on the membrane, and this is achieved by such devices as loading the membrane with different dyestuffs. In this process not only the sense of the potential but also the whole complex of surface forces are altered. The corresponding method of charging amphoteric membranes (*e.g.*, gelatin) by changing the pH of the solutions has also similar complications. To get over this difficulty and to get a membrane whose change can be easily changed, N. V. Kultascheff and F. A. Santalow (*Z. anorg. allgem. Chemie*, 1935, **223**, 177) have studied the preparation and properties of metallic membranes. These membranes are successfully prepared by heating a thin foil of an alloy of two metals (*e.g.*, brass) so that the more volatile component evaporates leaving behind a membrane with pores of nearly molecular dimensions.

Atomic Weight of Protactinium.

THE atomic weight of not a single member of the Actinium series has so far been determined by purely chemical methods. Aston's work on Actinium D has no doubt given the value for the atomic weight of Protactinium as 231. In spite of the difficulties in getting appreciable quantities of Protactinium, A. V. Grosse (*Proc. Roy. Soc.*, 1935, **150**, 363) has prepared the double fluoride K_2PaF_7 in the highest state of purity, and after careful conversion to Pa_2O_5 found the ratio $K_2PaF_7 : Pa_2O_5$. He gives the mean value for the atomic weight of Pa as 230·6 with an accuracy of ±0·5. This precision determination of atomic weight is of importance in fixing up the atomic weights of the other members of the actinium series.

M. P. V.

Surface Tension of Aqueous Solutions of Electrolytes.

G. JONES AND W. A. RAY (*J. Am. Chem. Soc.*, 1935, **57**, 957) find that the surface tension of a sufficiently dilute solution of an electrolyte is *lower* than that of water itself. This observation is of great interest, if it is confirmed and shown to be a general phenomenon; and is of particular importance as it is not in accordance with the theories developed by Wagner and later by Onsager and Samaras.

K. S. G. D.

On the C—C Bond Energy.

W. LASAREFF has recently made a calculation of the C—C bond energy in diamond and aliphatic molecules (*Physica*, 1935, **2**, 737) which widely departs from the accepted values. He has argued that a carbon atom is in the (^5S) state while a carbon atom in the gaseous state is in the (^3P) state ($\triangle E = 97 \pm 5$ k. cals.) and that the difference between the energies of these two states has to be considered when calculating the C—C bond energy by means of the data regarding the sublimation heat. Lasareff's value for the bond energy in diamond is 132±3·5 k. cals., while the accepted value is about 75 k. cals.

Lasareff has also calculated the bond energy in the aliphatics which comes to 128 k. cals. It is clear that this calculation of the C–C bond energy will lead to important consequences for many problems in chemical calculations.

N. S. N.

Vitamin K.

THE nature and distribution of a vitamin, possessing curative properties against a deficiency disease resembling scurvy in chicks, but which cannot be prevented by ascorbic acid, has been described by Henrik Dam (*Biochem. J.*, 1935, **29**, 1273). The factor is designated Vitamin K, and constitutes the anti-hæmorrhagic factor (or factors) in the diet. It is fat soluble, being found in the easily soluble non-sterol fraction of the unsaponifiable matter. It occurs in hog liver, hemp seed, and in certain vegetables like tomatoes, kale and orange peel. It is different from Vitamins A, D and E; cod-liver oil is practically devoid of it. There is an enormous retardation of the clotting of the blood of chicks suffering from this hæmorrhagic diathesis, and the quantitative estimation of the Vitamin is based on the determination of the clotting time.

Asexual and Sexual Reproduction in Ascidians.

N. J. BERRILL (*Journ. Morph.*, 1935, **57**, No. 2), as a result of the comparative study of a number of ascidians, has come to the conclusion that the processes of bud development and sexual development are, in the ascidians, at variance. Initial bud masses may consist of cells varying from 40 (Distaplia) to 1,000 or more (Ectinascidia) and in all cases the cells undergo a number of cleavages before differentiation begins. Gross differentiation into parts of the organism occurs first and only later cytological or cellular differentiation is seen. In sexual development cleavage and differentiation are fundamentally dissociable, the rate of cleavage and the number of cells produced dependent on the yolk-cytoplasm ratio and the size of the egg respectively. Often in early development the differentiation noticed, refers not to the differentiation of the adult structure but to the precocious differentiation of peculiar larval structures. In some cases a telescoping of the differentiation of the larval structures takes place, without, however, affecting the development of adult structures. The author concludes that the difference between asexual and sexual reproduction really consists in the presence of a larval organisation in the latter, whose differentiation is due to the liberation of substances in the egg during maturation. The rest of the egg unaffected by this substance and which must solely be responsible for the development of the adult organism is usually small and repeated division must precede the differentiation of adult characters.

Development of *Patella vulgata*.

THE embryology of *Patella* is, in spite of the earlier memoirs of Wilson and Patten, still incomplete and in a number of respects our knowledge of this subject is inaccurate, as shown by F. G. W. Smith in his latest paper [*Phil. Trans. Roy. Soc. Lond.*, 1935, **225**, No. (B) 520, 95–125]. The divergence of opinion between Wilson and Patten regarding the origin of endoderm and mesoderm cells is cleared by the present author who states that the whole of the macromere in the quadrant D gives rise to mesoderm while the macromeres of quadrants A, B and C alone give rise to the endoderm. The foot arises in the form of single median protuberance. The development of the radula is for the first time completely followed and it is seen that the radular formula undergoes two changes before it assumes the adult arrangement. The entire process of torsion is described as well as the changes during metamorphosis.

A Petrographic Use of Fluorescence.

TILL now the property of fluorescence has been used for the determination of individual minerals. But recently Alonzo Quinn (*American Mineralogist*, Vol. **20**, No. 6) has shown that such a study could be extended to identify the textural relationships in igneous rocks, if they are photographed in ultra-violet light under special conditions. In connection with his study of the nephelite syenite, he has reproduced several such photographs where the distinction between the minerals is very clear. The hornblende is black, sodalite white and felspar and nephelite grey, thus showing that sodalite was the fluorescent mineral. Though such an investigation involves the employment of different types of films, filters and other specialised appliances for different rocks, yet the method will have considerable value

in the determination of textural relationships of minerals—especially fluorescent—in rocks.

Differentiation in Hawaiian Lavas.

AT the present time a good deal of work has been done on the crystallisation of basaltic magma. For most of the American petrographers Hawaiian lavas have become the common material for petrographic work, and Barth's work on the rocks of the Hawaiian Islands has become classic, and his conclusions are in keeping with the experimental deductions of Bowen. But recently Howard A. Powers (*American Journal of Science*, V Series, No. 175) with an intimate knowledge of the Hawaiian volcanoes and lavas, has drawn attention to certain features which vitally affect the theories of magmatic differentiation. He has been able to trace a definite relation between magmatic differentiation and cycles of volcanic activity, and opines that "basalt of uniform composition represents essentially undifferentiated primary magma and the occasional eruptions of the decadent stage bring to the surface the various products that result from the differentiation of the original magma". With regard to the crystallisation of the pyroxenes in basalts he differs from Barth and holds that diopside phenocrysts do not form in primary magma and that orthorhombic pyroxenes should not be omitted from the sequence of pyroxenes in basalts.

Discussing the problems of magmatic differentiation so far as it applies to Hawaiian lavas, he has shown that different phases of volcanic activity produce different types of basalts from the most undifferentiated lime-basalts to the most highly differentiated nephelite-melilite basalt. In conclusion he suggests that "fractional crystallisation alone is not sufficient to explain the differentiation of the Hawaiian lavas".

Science Notes.

Growth of the Shoot in Asparagus racemosus *Willd.*—Mr. S. Sarup writes:—The elongation of the shoot of *Asparagus racemosus* Willd. is very rapid in the beginning, attaining a definite length before the axillary shoots begin to grow. Four shoots in a single young plant reached 80·5 cms., 76·7 cms., 75·9 cms. and 83·0 cms., in about a week's time. This height varies with the age, and the size and number of rhizomes. It was 300 cms. and 150 cms. in two other plants of different ages. In a young plant of *Asparagus sprengerii* the three shoots reached 29.4 cms., 32.0 cms., and 27.2 cms., respectively.

Growth of the shoot of Asparagus racemosus: *increase in cms. after every* 12 *hours.*

1st shoot								4.7	6.0	3.3	6.3	6.5	6.7	7.6	6.5	5.2	5.9	1.6		
2nd shoot					4.9	3.8	4.8	6.7	6.0	7.7	6.6	8.4	8.7	7.3	7.9					
3rd shoot	1.0	2.0	2.0	3.0	4.0	5.8	4.4	5.8	4.1	5.9	4.2	7.8	7.5	2.5	6.9	6.0	5.5	1.5	1.6	
	Slow					Rapid							Max.					Slow		
2nd shoot	..							4.8	6.7	6.0	7.7	6.6	8.4							
3rd shoot	..							4.0	5.8	4.4	5.8	4.1	5.9	4.2	7.8					
Shoot of *Asparagus sprengerii*	..							1.2	4.2	1.7	3.2	1.8	1.6	1.2						

The growth rate is slow in the beginning, then it becomes rapid until it attains a maximum when it gradually falls off. Taking the actual figures in one case (3rd shoot) we find that the rate of growth rises slowly in the early stages, then it becomes more rapid till it goes up to 7.8 cms. and 7.5 cms. every 12 hours and then it falls to 6.9 cms. for 12 hours. Then it begins to decrease a little till it falls from 5.5 cms. to 1.5 cms. The figures for the other shoots follow the same course.

The readings in the last column were begun as soon as the shoot tip had just come out of the earth and the observations were continued till the axillary shoots were developed. Some discrepancies are due to the fact that external conditions were not uniform.

There appears to be a periodicity in the day and night rates of growth. The suggestive figures for the 2nd and 3rd shoot are like this:—

In *Asparagus racemosus*, the rate of growth is about 25 per cent. higher in the day than in the night. During the day the plant is adding new material continually (*cf.* Blackman, V. H., *Annals of Bot.*, **33**, 353).

* * *

The Quaternary System CaO-Al_2O_3-SiO_2-Fe_2O_3 in Relation to Cement Technology—Building Research Technical Paper No. 16. His Majesty's Stationery Office (Post Free 1*s.* 1*d.*).—The

demand for Portland cements possessing special properties has caused much attention to be devoted to the constitution of Portland cement and to the content of the various compounds present in it. The present report represents an application to cement technology of the results of a study of a portion of the quaternary system CaO-Al_2O_3-SiO_2-Fe_2O_3. The data available from that work permit of a closer definition of the conditions obtaining during the clinkering of a cement raw mix, and of the compound content of the clinker, than has previously been possible.

* * *

Report of the Chemistry Research Board for the Period ended 31st December, 1934—His Majesty's Stationery Office (Price 1*s.* 8*d.* Post Free).—The report gives a general review of the activities of the Chemistry Research Board's work started in the Chemical Research Laboratory in 1925. The Director of Chemical Research describes in broad outline the current researches, many of which are conducted with the aid of financial contributions from firms and institutions. In view of the nature of the researches, both academic and industrial, chemists will be interested in this first report which in one volume summarises the results previously published in numerous scattered papers.

* * *

The Relation between Illumination and Industrial Efficiency 1. The Effect of Size of Work.—His Majesty's Stationery Office (Price 4*d.* Post Free 5*d.*).—This paper describes the first stage of an investigation the object of which is to find out whether the amount of light required for the efficient performance of the various tasks that have to be carried out in industry can be approximately calculated by examining the separate factors which together make up each visual task. The chief of these factors are size of object, contrast, rate of movement, and possibly colour; and the present paper gives the results of investigation to discover the effect of variations of size upon the illumination required. Further papers upon the relationship of contrast, and rate of movement, with illumination will follow.

* * *

Effect of Storage prior to Ginning on the Spinning Quality of Cotton.—Storage of seed-cotton for any length of time prior to ginning often brings about considerable modifications in the quality of the seed and the lint. The seed is apt to lose in germinating power and the lint to be attacked by bacteria and fungi which are associated to a greater or lesser extent with cotton. There is, however, a school of thought which holds the view that the quality of cotton, stored in seed, improves as a result of a sort of conditioning process during which the development of the fibre continues and some of the oil from the seed flows into it making it soft and pliable and thereby improving its spinning quality. This subject is fully discussed in the latest bulletin of the Indian Central Cotton Committee entitled *Effect of Storage prior to Ginning on the Spinning Quality of Cotton*, by Dr. Nazir Ahmad, M.Sc., Ph.D., F.Inst.P., Director, Technological Laboratory, Indian Central Cotton Committee. The author points out that in spite of the practice of storing cotton in seed, no experiments have so far been reported to test the validity of the above-mentioned views. He then gives an account of the experiments undertaken by him at the Laboratory which show that the storage of cotton in seed before ginning has no effect whatever either upon its mean fibre-length or fibre-weight per inch, showing that there is no justification for the view that the development of the fibre continues during storage. The results of spinning tests and wax determination on three Punjab cottons, *viz.*, Punjab-American 289F, Punjab-American 4F and Mollisoni, revealed that in the case of two cottons storage of seed-cotton before ginning did not bring any improvement either in the wax content or in the spinning performance. In the case of one cotton only, namely P.A. 289F, a small improvement in wax content and spinning performance was observed, but it would be rash to regard it as an argument in favour of delaying the ginning operation and to ignore the harmful effects of storage upon the quality of seed and lint. Giving overwhelmingly strong reasons against the practice of storing the seed-cotton, the author is of opinion that, if by force of circumstances, it should become necessary to store the seed-cotton for a while before ginning, every precaution should be taken to ensure the dryness of the sample, the absence of large quantities of dirt or trash and the absence of a particularly warm or humid atmosphere in the store room. If the period of storage should exceed a few weeks the seed-cotton should be occasionally taken out and exposed to sun. The booklet, which is available at the nominal cost of annas eight, has the rare feature of being useful to all interested in cotton industry, and for the production of which the author should be congratulated.

* * *

Indian Central Cotton Committee.—The 31st meeting of the Indian Central Cotton Committee was held on the 19th and 20th August, 1935, at the headquarters of the Committee, Vulcan House, Nicol Road, Ballard Estate, Bombay, under the presidency of Dewan Bahadur Sir T. Vijayaraghavacharya, K.B.E., Vice-Chairman of the Imperial Council of Agricultural Research, His Excellency the Governor of Bombay addressed the meeting.

Numerous questions of vital importance to the cotton industry in India were discussed. The agenda of the meeting included items on the formation of a compact block of long staple cotton in Sind and Government of Bombay's resolutions thereon; licensing of gins and presses; standardisation of weights for cotton transactions; proposed additions and amendments to the bye-laws of the East India Cotton Association Ltd., relating to cotton options and the scheme for the publication of cotton forecasts. Broadcasting in the mornings of commercial news on cotton; railway freight rates on cotton and the mixing of Punjab-American cotton were also discussed.

In addition to the above, as is usual at the monsoon meetings the Committee reviewed the progress made on its various research and seed schemes.

Among the new schemes proposed to be introduced are (1) scheme for introduction and extension of B.D. 8 cotton in Broach district, (2) scheme for extension of cultivation of long staple cotton in Bengal, and (3) revised seed schemes for the distribution and extension of Jaywant and Gadag

No. 1 cottons in the Southern division of the Bombay Presidency.

* * *

Biochemical Society, Calcutta.—At the Annual General Meeting of the Biochemical Society, Calcutta, held at the All-India Institute of Hygiene on July 11, the annual report of the Secretary and Treasurer was presented by the Secretary, Dr. B. C. Guha. In course of the report, the Secretary said "The Biochemical Society, Calcutta, was inaugurated in a meeting held at the All-India Institute of Hygiene on July 6, 1934. The need of such a Society for the promotion of biochemical studies and research had been felt for some time and it was hoped that the creation of such a scientific body in Calcutta would evoke local response. In this expectation the promoters of the Society have been fully justified. The record of last year's work shows good progress and stimulates hope for the future."

Since the inauguration of the Society in July, 1934, ten meetings have been held in which the following fourteen papers have been read and discussed. The papers display a wide range of interests.

(1) B. Ahmad—The Metabolism of Carotene. (2) A. C. Roy—Cultivation of micro-organisms on vegetable media. (3) S. C. Banerjee and H. K. Sen—Catalytic activation of diastase. (4) R. C. Bhattacharjee—The therapeutic applications of snake venom. (5) A. R. Ghosh and B. C. Guha—Vitamin C in Indian foodstuffs. (6) B. Ahmad—The excretion of Vitamin C in human urine. (7) P. C. Mitter and N. N. Chatterjee—The formation of purines from iminazoles. (8) B. N. Ghosh—The combination of antigens with anti-bodies. (9) N. R. Chatterjee, D. N. Chatterjee, Pasricha and S. Ghosh—Effect of bacteriophage on the enzyme activity of vibrio choleræ. (10) A. C. Roy—Biochemistry of snake venom. (11) J. S. Chowhan—Therapeutic uses of snake venom. (12) B. C. Guha and H. G. Biswas—Flavines and Vitamin B_2. (13) B. C. Guha and A. R. Ghosh—The biological synthesis of ascorbic acid. (14) H. E. C. Wilson and S. L. Mukherjee—Some observations on the composition of the urine in relation to calculus formation.

At the annual meeting, the following papers were read:

(1) N. Das and B. C. Guha—The respiration of *Bact. Staphylococcus.*

(2) A. R. Ghosh and B. C. Guha—The relation between dietary composition and the urinary excretion of ascorbic acid.

For the next year the following have been elected to form the Committee:

Mr. N. M. Basu, Dr. P. K. Bose, Dr. P. De, Dr. J. N. Mukherjee, Dr. S. N. Ray, Mr. A. C. Roy, Dr. B. B. Sen and Dr. H. E. C. Wilson. Dr. S. Ghosh and Dr. B. C. Guha have been elected Honorary Secretaries and Dr. B. Ahmad, Honorary Treasurer.

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Association of Economic Biologists, Coimbatore.—A meeting of the Association was held on the 26th June 1935. Two interesting papers were read:—(1) Intercultivation in dry cottons by V. Ramanatha Ayyar; (2) Effect of certain cultural practices on the cocoanut by J. S. Patel and K. W. Chakrapani Marar. On 22nd July 1935, Mr. W. B. Gurney, Entomologist, New South Wales, Australia, delivered an interesting lecture on "Some aspects of Economic Entomology in Australia". On 29th July 1935, Dr. E. K. Janaki Ammal read an illuminating paper on "Cytogenetic studies in *saccharum Spontaneum* L."

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Academy of Sciences, U.P.—The ordinary monthly meeting of the Academy was held on Saturday, April 20, 1935, at 9-30 a.m. in the Physics Lecture Theatre under the presidency of Prof. N. R. Dhar and was attended by a large number of members. The following were elected new members of the Academy:—Drs. Rangadhama Rao and Ramkrishna Rao of the Andhra University; Profs. N. R. Sen and P. C. Mahalanobis of the Calcutta University; Dr. D. N. Wadia, Geological Survey of India; Prof. Ajrekar of the Guzarat College; Dr. Rangaswami Ayyangar of the Rice Research Institute, Coimbatore; Dr. Normand, Director-General of Meteorology; Rao Bahadur B. Viswanath, Imperial Agricultural Chemist, Pusa; Prof. Mowdawalla, Principal of the Government Engineering College, Bangalore; Lt.-Col. R. N. Chopra, Principal, School of Tropical Medicine, Calcutta; Mr. Champion, Silviculturist, Dehra Dun; and Mr. Pinfold of the Attock Oil Company.

The President made a short speech reviewing the progress of the Academy. He said that in view of the increasing number of papers received by the Academy, the Bulletin has been converted to Proceedings. It is gratifying to find that the publication has been much improved, and it is now quite regular. The position of the Academy has been recognised by foreign learned bodies like the Academy of Sciences, France, the Prussian Academy of Sciences, the National Academy of Sciences of America, the Royal Society of Edinburgh, the Imperial Academy of Sciences, Japan and about a hundred other bodies which are regularly exchanging their publications with ours. The Council has recommended that a temporary officer be appointed next year to deal with the publication and quick despatch of business. The Academy has been recognised to be an all-India body by the Indian Science Congress, and it is gratifying to find that a large number of Scientists of repute from other parts of India have agreed to join the Academy.

In view of the changed circumstances, the President remarked that the Council of the Academy has decided to widen its scope of activities, and has redrafted the existing rules and regulations. It has been decided to increase the number of Fellowships to one hundred and change the name to "National Academy of Sciences, India". These proposals are now being circulated amongst the members, in accordance with company rules, and after the usual ceremony, will be placed before the Academy for final sanction.

The Government of the United Provinces has very kindly sanctioned a recurring grant of Rs. 2,000 per year, and appeals have been made to other Governments and learned bodies for financial grants to enable it to cope with its increased activity. The President hopes that in view of the increasing usefulness of the Academy to the country, these appeals will meet with response. The Academy is already finding its accommodation cramped and an appeal for a building fund will shortly be issued.

About a dozen papers were read before the Academy. The President read a paper in which

he showed that the addition of molasses to the soil considerably aids the fixation of nitrogen and this is ascribed partly to the action of light in the tropics. Dr. S. Dutt described the isolation, analysis and the synthesis of the active principle of an Indian Medicinal plant *Glycosmis pentaphylla* which is highly recommended by the Indian physicians for a number of diseases. Mr. Satyendra Ray's paper on a modified theory of gravitation base on Sulaiman's theory provoked very active discussion and his assumptions and method of work were criticised by Dr. Kothari from Delhi and Dr. Mazumdar from Lahore. Messrs. Agarwal and Dutt described the results of their analysis of the bark of *Terminalia arjuna*, a plant of great medicinal use. Messrs. Toshniwal and Pant described the results of their recent measurements of the height of the ionosphere and its electron content. Mr. Bajpai described certain anomalous results which he obtained on the measurement of the height of ionosphere during the total lunar eclipse. Mr. S. P. Jain read a paper on Taylor's Series and Borel's Polygon of Summability.

Mr. Har Dayal Srivastava described a new parasite referable to a new genus of the Subfamily *Dinurinæ*. It is a very rare parasite in the stomach of ilisha fish. In another paper Mr. Srivastava gave an account of a new member of the family *Monorchidæ* from sauri fish. Mr. B. P. Pande read his contributions to the Digenetic trematodes from the microchiroptna of Northern India. Mr. S. C. Varma described new species of *Bucephalopsis* and *Bucephalus* and provisionally created a new genus *Trilentacularia*.

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Report of the Extraordinary Monthly Meeting of the Academy of Sciences of the United Provinces of Agra and Outh held on Friday, May 10, 1935, at 6 P.M.:—Prof. A. C. Banerji, Vice-President of the Academy, was in the Chair. The following papers were read and discussed:—(1) MESSRS. R. N. GHOSH AND L. P. VARMA, Physics Dept., Allahabad University, Allahabad: *On the Application of Heaviside's method to the Problem of Vibrations of Pianoforte String.* (2) MR. HAR DAYAL SRIVASTAVA, M.Sc.: *New Amphistomatous Parasites from an Indian Freshwater Fish.* (3) MR. HRISHIKESHA TRIVEDI, M.Sc.: *The Absorption Spectra of the Vapours of Oxides of Copper, Iron, Nickel and Cobalt and the Determination of their Heats of Sublimation.* (4) MR. HRISHIKESHA TRIVEDI, M.Sc.: *The Absorption Spectra of the Vapours of the Mono-Sulphides of Iron, Nickel, Cobalt, Copper and Tin, and the Determination of their Heats of Sublimation.*

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Scripta Mathematica: April 1935 (Vol. III, No. 2) R. C. Archibald. "*Mersenne's Numbers.*"—An authoritative paper giving "accurate and complete information concerning present knowledge" of what are known as Mersenne's Numbers—the 55 numbers 2^p-1 where p is one of the primes 2, 3, ..., 257. Indian Scientists will note with an element of delight that V. Ramesam has been quoted as the first to give two of the factors of $2^{71}-1$, *viz.*, 48544121 and 212885833. (*Journ. Indian Math. Soc.*, 1912, **4**, 56.)

The same author in a paper which is concluded in this issue gives an up-to-date account of the results which have been obtained in the attempts to prove the famous Goldbach's Theorem.

* * *

The Perpeti Meteorite.—One of the interesting exhibits shown and commented upon by Dr. A.L. Coulson, at the ordinary meeting of the Asiatic Society of Bengal held on Monday, the 5th August 1935, was the Perpeti Meteorite. "At 11 P.M. on the 14th May 1935, a meteoric shower occurred in the vicinity of the villages of Perpeti (23° 19′ 30″ : 91° 0′ 0″), Bhateswar, and Pilgiri under the jurisdiction of the Chandina police station, and near other villages under the police stations of Kachua and Hajiganj, in the Tipperah district of Bengal.

"Eleven pieces in all were recovered. The total weight of all specimens is 21,942·57 grams; the largest one weighs 6,689·85 grams. The specific gravity of the meteorite is 3·554. It is being analysed by Mr. P. C. Roy.

"The meteorite, which has been registered as No. 298, Stone, in the collections of the Geological Survey of India, has been classified provisionally as No. 14, White Chondrite (Cw.) in Brezina's terminology. It has a white, rather friable mass with few, chiefly white, chondri."

* * *

Gift of the International Union of Chemistry.—The last Conference of the Union held in April 1934 in Madrid, eager to help the Committee of the A.T.C. to go on with the work, had agreed to transfer to the Committee an important part of the Funds of which the Union disposes.

This decision was voted unanimously by the Union's Executive in Paris, October last and confirmed by National Organisations representing the various countries at the Union (*e.g.*, Verband Deutscher Chemischer Vereine representing Germany, Comité National Belge de Chimie representing Belgium, National Research Council, Division of Chemistry representing the United States, etc.).

The sum thus put at the disposal of the Committee of the A.T.C. is 150,000 francs. The large amount shows the interest which the international chemical circles attach to the continuation of the A.T.C. This sum will be used up for the printing of the Index of the second series (Vols. VI to X—1923-30), now ready at the Editorial Office.

In compensation of this gift the Committee of the A.T.C. is going to put at the disposal of the chemical organisations adhering to the Union a certain number of complete sets. This number and the mode of their distribution are to be established shortly. (*Communicated by Dr. Ch. Marie, General Secretary of the A.T.C.*)

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A three-year entomological scheme to combat a serious cotton pest due to a black-headed cricket, has been approved by the Sind Cotton Committee, at a recent meeting. The Scheme will be submitted to the Sind Central Cotton Committee for grant of financial aid.

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The Institute of Brewing.—The Collective Index of the *Journal of the Institute of Brewing* for the years 1924-34, inclusive, will shortly be published. The price will be 12*s.* 6*d.* to Members and 25*s.* to non-Members, postage free. Those who are desirous of securing a copy of this publication

may communicate with *The Secretary, Institute of Brewing, Brewers' Hall, Addle Street, London, E. C.* 2.

* * *

New Broadcasting Station at Delhi.—The main details of the new broadcasting station at Delhi, which is to be erected and worked by the Indian State Broadcasting Service are now settled. The transmitting station will be located to the north of Old Delhi on the Ambala Road near the intersection of Probyn Road and the Mall and the construction of the station building will be begun shortly. The frequency response is substantially uniform from 30 to 10,000 cycles per second, which will give reproduction of a very high standard. The wavelength chosen for initial working is approximately 349 metres, the precise frequency being 882 kilocycles per second. In order to obviate any possible interference to be caused to reception of Indian stations in India by high power broadcasting stations in Europe and other parts of the world, particularly at night and at the extreme range of the Indian stations, a continuously variable valve-type of frequency control has been selected in preference to a crystal, which would not permit of any rapid change of wavelength. The frequency stability of the apparatus chosen is adequate for Indian conditions.

As regards power, the station is rated at 20 kilowatts to the aerial with distortionless modulation of 90 per cent. and the station will thus have an effective power more than ten times that of the present stations of the Indian State Broadcasting Service at Bombay and Calcutta. The aerial system will be of the quarter-wave type and will be supported by two masts 100 metres high, *i.e.*, approximately 330 ft. The masts which are of the stayed lattice type, will be insulated from the ground and their electrical properties can be adjusted in order to increase the radiation in certain directions. This will permit the energy to be directed towards the more densely populated areas which lie roughly to the north-west and south-east from Delhi. The mast alignment has been adjusted to this direction.

It is generally agreed, that in the absence of exceptionally severe atmospherics and interference from electrical apparatus, a field-strength of one millivolt per metre should give reliable reception with comparatively simple receivers. It is estimated that the Delhi station will give this field-strength upto a distance of 85 miles in all directions during the day. Modern receivers will, however, give good results when conditions are reasonably favourable with a field-strength of one-tenth millivolt per metre and the Delhi station is estimated to give this field-strength upto a distance of 240 miles. It is fairly certain that during the cold weather and at other times when conditions are favourable, Lucknow and Cawnpore to the south-east and Lahore to the north-west will be able to receive the Delhi station even during the day time. It is anticipated, however, that on the average, field-strength at night will be about one-third millivolt per metre upto 600 or 700 miles, which will bring within range of Delhi practically the whole of Northern India, including most of the hill stations in the Himalayas.

Apparatus has also been ordered for the fitting of the studios in accordance with the best modern practice, but the precise location for the studio has not yet been decided.

As regards programmes, a service of about 4 hours daily will be provided at first, though this will probably be increased as support is obtained in the form of licences in the neighbourhood. A very substantial portion of the programme will be in Indian languages and based on the indigenous culture of the surrounding area. The proportion of European programmes will depend on evidence of the public taste obtained in practical working. The British Broadcasting Corporation have kindly granted permission to the Indian State Broadcasting Service to relay the programmes of the Empire Broadcasting Service and arrangements will be made to construct a special receiving station near Delhi for this purpose. European programmes of a high quality will thus be available. Arrangements will also be made for items specially directed towards the general uplift of rural districts in the immediate neighbourhood.

It is not possible at this stage to give a definite date by which the station will be working, but it is hoped that experimental programmes will be given in November and that regular programmes will be broadcast well before the end of the next cold weather.—(*Extracted from the Indian Radio Times*, 22nd May 1935.)

* * *

Colloidal Copper for Leprosy.—Dr. William Noble of the Salvation Army in Travancore, as a result of his work in collaboration with Dr. Denny of the Leper Colony, Louisiana, will soon start a new treatment which has already given very good results in the hands of Dr. Denny, for Leprosy. The disease is due to a microbe which occurs only in persons who are pre-disposed due to mal-nutrition and weakness, and is generally caused through other illnesses. By building up resistance and concentrating solely on proper feeding and curing of other diseases, the leprosy microbes not only decreased in intensity but also ultimately disappeared. The treatment is slow compared with the unpleasant chaulmoogra. More recently colloidal copper has been found to be a good substitute for the chaulmoogra. The treatment is rapid and effective and very good results have already been obtained by Dr. Denny by copper injections.

* * *

Ootacamund Observatory.—At the instance of the Ootacamund Municipality, the India Meteorological Department has restarted the observatory at Ootacamund which was in existence from 1901 to 1923. The usual instruments of a III class observatory, *viz.*, a barometer, a Stevenson screen, a set of four thermometers, an anemometer, a wind vane and a rain-gauge, have been loaned by the India Meteorological Department and have been installed at suitable sites under the personal supervision of an officer of the department who was deputed to the station for the purpose in the 1st week of July.

The observatory will be maintained by the Municipality and will be under the technical supervision of the India Meteorological Office. For the present, a copy of the daily meteorological data will be posted by the Municipality to the India Meterorological Office in monthly registers.

Professor A. C. Seward, Professor of Botany, Cambridge University, has been invited by the Indian Universities to deliver a series of lectures at the various educational centres in India.

* * *

We learn with great pleasure that Dr. B. K. Das, Professor of Zoology, Osmania University, Hyderabad (Deccan), having received a special invitation from the International Zoological Congress to be held at Lisbon, is being deputed to attend the same. He will read a paper on "Certain characteristic features of the Hyderabad fauna". Besides, he will also deal with certain important aspects of the Osmania University for which he has been requested by the Congress. He is sailing on the 20th of this month and will be back about the 1st week of November next.

* * *

It is understood that Professor J. N. Mukherjee, of the University of Calcutta, will be deputed by the Imperial Council of Agricultural Research to represent India at the International Soil Science Conference, London.

* * *

Sir Hari Singh Gour and Dr. M. A. Moghe of the Nagpur University will represent the University at the next Quinquennial Congress of Universities of the Empire to be held at Cambridge in 1936.

* * *

The Hon'ble Mr. A. G. Clow, C.I.E., I.C.S., Joint-Secretary, Department of Industries and Labour, Government of India, has been appointed as the first Chairman of the newly created Council of Industrial Intelligence and Research Bureau of the Government of India.

* * *

The Andhra Scientific Co., Ltd., Masulipatam.—We have recently received from Messrs. The Andhra Scientific Co., Masulipatam (S. India), a "check valve" and a reprint of a paper on the device published in the *Journal of the Indian Chemical Society* (1934, **11**, 659). The valve constitutes a very simple device for effectively preventing back suction which is a common experience, due to slight diminution in the rate of evacuation, in the laboratory. In actual use, the valve comes next to the pump so that when the pump is disconnected, the reduced pressure in the evacuated space is maintained. This has now been placed on the market and thus made widely accessible.

We also understand that the Company have specialised in the manufacture of special regulator resistance for high output suitable for 120 and 220 volt mains, weight boxes, balances and drying ovens, of standard quality. They are also prepared to undertake manufacture of any new laboratory device from scientific workers.

* * *

We are glad to felicitate Dr. Muhammad Abdul Hameed Siddiqui, Professor of Anatomy, King George's Medical College, Lucknow, on his being awarded the Vincent Massey Scholarship.

Professor Siddiqui took the B.Sc. Degree in 1923, from the Canning College, Lucknow University. He then joined the King George's Medical College, Lucknow, and passed the M.B., B.S. examination in 1928, with distinction in Pathology coming out First in the University. He was the recipient of a University Scholarship and many medals and certificates of honour. In 1930, he took the M.S. degree of the University, being the first candidate to get that degree from the University. He went to Europe for higher studies and in 1931, he obtained the D.L.O. & R.C.S. (Eng.) and in 1932, the F.R.C.S. degrees. In 1932, he was appointed Professor of Anatomy, King George's Medical College, Lucknow, which appointment he is holding to date. In 1933, he went to London for a short period to attend the meetings of Anatomical Society of Great Britain.

* * *

Announcement :—

Woodhouse Memorial Prize, 1935.—Mr. C. A. MacLean, Officiating Director of Agriculture, Bihar and Orissa, writes :—

"In memory of Mr. E. J. Woodhouse, late Economic Botanist and Principal of Sabour Agricultural College who was killed in action in France in 1917, a biennial prize in the form of a silver medal and books of a combined value of Rs. 100 will be awarded to the writer of the best essay on a subject of botanical interest to be selected from the list noted below. The length of the essay should not exceed 4,000 words.

1. Intergeneric hybrids and their importance to agriculture.
2. The problem of rust of wheat in India.
3. The constancy of agricultural and botanical characters of paddy and their suitability for being used in a scheme of classification.
4. Rotation of crops in relation to the eradication of weeds.

The competition is open to graduates of Indian Universities and to Diploma holders and Licentiates of recognised Agricultural Colleges in India, who are not more than 30 years of age on the date of submission of their essays.

Papers should be forwarded to the Director of Agriculture, Bihar and Orissa, Patna, before November 1st, 1935.

Failing Papers of sufficient merit, no award will be made. Essays must be typewritten on one side of paper only.

* * *

We acknowledge with thanks the receipt of the following :—

"Transactions of the Faraday Society," Vol. XXXI, Pts. 1-7, Jan.—July 1935.

"Actualites Scientifiques et Industrielles," Nos. 222, 225, 230-234, 236, 240-248, 254-255 and 261.

"Bibliotheque Scientifique Belge—La Spectroscopie appliquee." (Hermann et Cie, Paris).

"Journal of Agricultural Research," Vol. 50, Nos. 6 and 7.

"The Journal of the Royal Society of Arts," Vol. LXXXIII, Nos. 4309-4313.

"Indian Journal of Agricultural Science," Vol. 5, Pt. II, April 1935.

"The Biochemical Journal," Vol. 29, No. 6, June 1935.

"The American Journal of Botany," Vol. 22, No. 7, July 1935.

"The Journal of the Indian Botanical Society," Vol. 14, No. 1, March 1935 and Index to Vol. 13.

"The Journal of the Institute of Brewing," Vol. XLI (Vol. XXXII, New Series), No. 7, July 1935.

"Canadian Journal of Research," Vol. 12, No. 6, June 1935.

"Chemical Age," Vol. 32, Nos. 834–835; Vol. 33, Nos. 836–838.
"Berichte der Deutschen Chemischen Gesellschaft." Vol. 68, No. 7.
"The Journal of the Indian Chemical Society," Vol. XII, No. 5, May 1935.
"Experimental Station Record," Vol. 72, No. 6, June 1935.
"Indian Forester," Vol. LXI, No. 8, August 1935.
"Forschungen und Fortschritte," Vol. 11, Nos. 19, 20/21.
"Department of Commercial Intelligence and Statistics, India—Monthly Statistics of the Production of Certain Selected Industries of India," February 1935, No. 11 of 1934–35.
"An Investigation of the Uplift Pressure on a Model of Bay IV. Khanki Weir and the Prototype," Vol. II, No. 10. (Research Publication: The Punjab Irrigation Research Institute.)
"Study of the Evaporation of Water from a Soil Surface with reference to the Fluctuations of Water-table," Vol. 5, No. 3, Nov. 1934. (Research Publication: The Punjab Irrigation Research Institute.)
"A statistical examination of the Uplift Pressure data obtained from Model experiments," Vol. 1, No. 5, Jan. 1935. (Research Publication: The Punjab Irrigation Research Institute.)
"The Wild Animals of the Indian Empire," Parts I and II. Journal of the Bombay Natural History Society, 1924.
"The Micro Post-Office Journal of the Engineering Association of Ceylon," No. 2, July 1935.
"Report of the Minister of Agriculture," Dominion of Canada, 31st March 1934.
"Tobacco growing in Canada," by N. A. Macræ.
"Farmer's business Organisations in Canada," Bulletin No. 173, New Series.
"Division of Forage Plants," Department of Agriculture, Dominion of Canada, for the years 1930–1933.
"Proceedings of the Academy of Sciences" (United Provinces of Agra and Oudh, India), Vol. IV, Pt. IV, May 1935.
"Indian Lac Research Institute, Annual Report for 1933–34."
"Bulletin of the Geological Institution of the University of Upsala," Vol. XXV.
"Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. LXXXVI, 1934.
"Rothamsted Experimental Station, Harpenden, Lawes Agricultural Trust," Reports for 1930, 1931, 1932 and 1933.
"Journal of the Indian Mathematical Society," Vol. I, No. 5.
"Nature," Vol. 135, Nos. 3425–3428, Vol. 136, No. 3429 and Index to Vol. 135, Jan.—June 1935.
"The Journal of the Bombay Natural History Society," June 1935.
"The Journal of Nutrition," Vol. 9, No. 6; Vol. 10, No. 1.
"The Journal of Chemical Physics," Vol. 3, No. 7, July 1935.
"Indian Journal of Physics," Vol. IX, Pt. 5, and "Proceedings of the Indian Association for the Cultivation of Science," Vol. XVIII, Pt. V.
"Journal de Chimie Physique," Vol. 32, No. 6.
"Research and Progress," Vol. I, No. 3, July 1935.
"The Journal of Russian Chemical Society," Tome V (LXVII).
"Records of Indian Museum," Vol. 36, Pt. IV.
"Science Progress," Vol. 30, No. 117, July 1935.
"Science and Culture," Vol. I, Nos. 2 and 3.
"The Indian Trade Journal," Vol. CXVIII, Nos. 1516–1519.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 3, 1933 (Index).

Academies and Societies.

Academy of Sciences (United Provinces of Agra and Oudh, India):

May 1935. L. P. VARMA: *On the Determination of Absorption Coefficient of Sound for Different Materials.*—Some Absorption Coefficients at 512 frequency for some commercial absorptive materials have been obtained by the Stationary Wave Method of E. T. Paris. The absorption coefficient of embossed metal plate coated with a blue paint (extensively used for ceilings of auditoriums) was found to be 0·25. BINAYENDRA NATH SEN: *On the Direct Formation of Bromides and the Distance of the Closest Approach of Atoms of Bromine.*—The distances of closest approach of atoms of metals determine their capacity to react with bromine. This value should be above 1·73 Å. BRAJ KISHORE MALAVIYA AND SIKHIBHUSHAN DUTT: *Photoreaction in Tropical Sunlight.*—2 per cent. solutions in appropriate solvents of aromatic amines, mono- and poly-hydric phenols, diamines, dyestuffs, aliphatic hydroxy acids, unsaturated acids, aminophenols and their derivatives, amino acids, aldehydes, hetero-cyclic compounds, aromatic oximes, phenylhydrazine and sulphocarbamide, were exposed to sunlight for periods varying from 42 to 156 days. The products obtained have been examined. N. R. DHAR AND S. K. MUKERJI: *Some Aspects of Nitrogen Fixation in Soil.*—The experimental results show that in absence of bacteria, the photo-oxidation of the energy rich compounds leads to the fixation of nitrogen in soils. MOHAMMAD HAMID KHAN: *On Eight New Species of the Genus* Cyclocœlum *brandes from North Indian Snipes.*—For the first time eight new species of the genus *Cyclocœlum* which are exclusively parasitic in the air sacs or the body cavities, have been described. B. P. PANDE: *Contributions to the Digenetic Trematodes of Microchiroptera of Northern India. I.*—Two new species of distomes belonging to the subfamily *Lecithodendriinæ* Looss and to the genus *Pycnoporus*, from the Indian insectivorous bats have been reported. HAR DAYAL SRIVASTAVA: *New Hemiurids (Trematoda) from Indian Freshwater Fishes. I.*—Two new species of *Lecithaster* have been reported from the common fresh water fish, *Clupea ilisha*. P. R. BHAGWAGAR: *Some Polyporaceæ from the Central Provinces.*—From a large collection of fungi made during the rainy season of 1930 from certain areas of Central Provinces, five species have been described. A. T. MOSHER: *Determining Sizes of Mangum Terrace Outlets.*—A formula has been derived for calculating the sizes for open channel terrace outlets for agricultural purposes.

Indian Academy of Sciences:

July 1935. SECTION A.—T. S. WHEELER: *On the Theory of Liquids. IV.*—Equations have been deduced for the forces on a particle vibrating in a spherical space under the influence of attractive and repulsive forces between that particle and uniformly distributed matter outside the spherical space. I. CHOWLA: *Some Problems of Waring's Type (III).* P. RAMA PISHAROTY: *Laminar Diffraction and the Becke Phenomenon.*—A sharp laminar edge appears as a dark line bordered by asymmetric fringes when examined in direct illumination under a microscope. This is explained as due to asymmetric diffraction effects at the edge. GURDAS RAM, V. I. VAIDHIANATHAN AND E. M. TAYLOR: *Potential Distribtuion in Infinite Conductors and Uplift Pressure on Dams.*—The distribution of pressure in the sub-soil under dams is the same as potential distribution in conductors. R. K. ASUNDI AND R. SAMUEL: *The Near Ultra-Violet Absorption Bands of SO_2.*—A number of new bands have been recorded and an analysis interpreting the bands as a uniform system is presented. A. VEERABHADRA RAO: *Raman Spectrum of Carbon Disulphide.*—The intensity distribution in 656 cm.$^{-1}$ is similar to that obtained in the wings accompanying the Rayleigh lines in liquids. R. VAIDYANATHASWAMY: *On the Arithmetico-Logical Symmetric Functions of* n *Attributes.* S. BHAGAVANTAM: *Hindered Rotation and Oscillation of Molecules in Liquids and in Crystals.*—The small oscillatory motions of liquid molecules about their equilibrium positions may be regarded as incomplete rotations, and this brings out a direct relationship between the optical anisotropy of the molecule and the intensity of the scattered line. N. R. TAWDE: *Some Aspects of Gross Intensities in Electric Bands with Special Reference to C_2 (Swan) and N_2 (Second Positive) Systems.*—The probabilities of transition, the temperatures and the "Centres of Intensity" have been discussed in relation to each other. K. S. KRISHNAN AND S. BANERJEE: *The Entropy of Manganous Ammonium Sulphate at Temperatures close to Absolute Zero, in Relation to the Magnetic Anisotropy of the Salt at Room Temperatures.*—The above relationship and its convenience for calculating θm. the characteristic temperatures are pointed out. S. BHAGAVANTAM: *The Carbon Isotope in Raman Scattering. Part I.*—The shifts 985, 1175 and 974 in benzene, cyclopropane and ethane are attributed to $C^{12}_2C^{13}H_6$, $C^{12}_2C^{13}H_6$ and $C^{12}C^{13}H_6$ respectively. S. BHAGAVANTAM: *A Suggested New Interpretation of the Structure of Band Spectra.*—It is found that large electric moments have to be postulated to account for the observed changes in the nuclear distances and vibration frequencies of highly polarisable molecules, thus indicating a fundamental relationship between the phenomenon of optical polarisability and electronic excitation. B. VENKATESACHAR AND L. SIBAIYA: *Isotope Abundance in Platinum.*—Exact analysis of the micro-photograms gives the isotopes and their relative abundance as 196 (16), 195 (13), 194 (10) and 192 (~2).

SECTION B.—L. S. RAMASWAMI: *Contributions to Our Knowledge of the Cranial Morphology of Some Ranid Genera of Frogs. Part II.*—The cranial characteristics of three South Indian aquatic forms of the genus *Rana* have been recorded. S. S. PATWARDHAN: *Three New Species of Trematodes from Birds.*—Three new species belonging to the genus *Neodiplostomum* La Rue, 1926, differing from the known species in the ratio of the fore-body and hind-body and other characters have been described. R. B. KULKARNI: *A Second Species of* Procamallanus *Baylis* 1923 *from India.*—A new species of nematode for which the name *Procamallanus planoratus* is proposed was isolated from the intestine of a Silurid fish, *Clarias batrachus* Bl. B. M. JOHRI: *Studies in the Family* Alismaceæ. *III.*—Sagittaria Guayanensis *H.B.K. and* S. latifolia *Willd.* H. R. BHARGAVA: *The Life-History of* Trianthema monogyna *Linn.*—The microsporogenesis and megasporogenesis of *Trianthema monogyna* Linn., belonging to the family *Aizoaceæ* has been described. S. K. NARASIMHAMURTHY: *The Life-History of* Ottelia alismoides *Pers.* FROILANO DE MELLO AND EMIDIO AFONSO: *Blood Parasites of* Coracias b. benghalensis *with Special Remarks on its Two Types of* Leucocytozoon.—Two species which are autonomous and independent have been described; while one of them may be classified as *Leucocytozoon*, the other has as all the parasites of this type, enough characters to constitute an independent genus to which the name Marcél léger should be attached. G. N. RANGASWAMI AYYANGAR AND K. KUNHI KRISHNAN NAMBIAR: *Studies in* Dolichos lablab (*Roxb.*) *and* (*L.*).—*The Indian Field and Garden Bean.* II—The seed coat colours constitute a case of linkage. S. RAMANUJAM AND N. PARTHASARATHY: *An Asynaptic Mutant in Rice* (Oryza sativa).—A mutant occurring in the bulk crop of one of the Coimbatore strains, Co. 4, has been described and observations of its meiosis reported. GOBIND SINGH THAPAR AND MAKUND BEHARI LAL: *On the Morphology of a New Genus of Trematode Parasite of the Kingfisher from Lucknow.*—A new genus *Psilorchis indicus* N.G., N.Sp. has been described. YAGNAVALKYA BHARADWAJA: *The Myxophyceæ of the United Provinces, India. I.*—Twenty-one forms of the algæ, of which seven are new species, three are new varieties and four are new forms, representing ten genera collected from Benares, have been described. C. R. HARIHARA IYER, R. RAJAGOPALAN AND V. SUBRAHMANYAN: *Investigations on the Rôle of Organic Matter in Plant Nutrition. X.—Influence of Different Forms of Manganese on the Oxidation of Organic Matter and Release of Plant Nutrients*—Treatment with different forms of manganese does not produce any appreciable difference in the quality of tomato. Experiments with varieties of tomato and ragi have convincingly demonstrated the advantages of supplementing organic manures with chemical oxidisers.

The Indian Physico-Mathematical Journal:

April 1935. S. CHOWLA proves that every large number is a sum of eight almost equal cubes—an improvement of a result due to E. M. Wright who had proved that every large number is a sum of *nine* almost equal cubes.

In another paper, S. Chowla improves another result of Wright connected with a Waring problem: If $v(k)$ denote the least value of s such that every integer can be expressed in the form $\sum_{i=1}^{s} e_i m_i^k$, where $e_i = \pm 1$ and m_i is a positive integer

or zero, then Wright had proved that $v(20) \leqslant 185$. Chowla proves that $v(20) \leqslant 161$. A further paper on the same subject by Chowla is to be found in *Quart. Journ. Math.* (Oxford), Vol. 6, No. 22.

Indian Chemical Society:

May 1935. UMAPRASANNA BASU: *Synthesis in the Pyridine Series.* RAJENDRA NATH SEN AND B. N. BANERJI: *Studies on Azo-aldehydes.* UMAPRASANNA BASU: *On Ketimine-enamine Compounds.* PRIYADARANJAN RAY AND JAGANNATH GUPTA: *Dimercaptothiobiazole as an Analytical Reagent.* C. NARAYANAN NAIR AND D. H. PEACOCK: *The Alkylation of Acetoacetic Ester by Toluenesulphonic Esters.* M. R. ASWATHANARAYANA RAO AND BASRUR SANJIVA RAO: *Investigations on the Adsorptive Property of Silica Gel. Part I—Chemical Activity of Residual Water in Activated Silica Gel.* M. R. ASWATHANARAYANA RAO: *Investigations on the Adsorptive Property of Silica Gel. Part II—Adsorptive Properties of Silica Gel containing Residual Hydrogen Chloride.* M. R. ASWATHANARAYANA RAO: *Investigations on the Adsorptive Property of Silica Gel. Part III.—Volume changes produced on displacement of adsorbed liquids in Silica Gel by water.* M. R. ASWATHANARAYANA RAO: *Investigations on the Adsorptive Property of Silica Gel. Part IV—Liberation of Air from Silica Gel Capillaries during Adsorption of Liquid.* M. R. ASWATHANARAYANA RAO: *Investigations on the Adsorptive Property of Silica Gel. Part V—Specific Gravity of Silica Gel under Various Liquids.* PHULDEO SAHAY VARMA AND K. S. VENKAT RAMAN: *Halogenation. Part X—Iodination of Xylenes and Monoiodoxylenes.* M. R. ASWATHANARAYANA RAO: *Selective Adsorption and its Significance. Part I. Nature of Selective Adsorption.*

The Indian Botanical Society:

March 1935. DASTUR, R. H.: *Light and Fundamental Life Processes of Plants.* I. BANERJEE, SACHINDRANATH: *Telephoraceæ of Bengal.* BRIJ MOHAN JOHRI: *Studies in the Family Alismaceæ—I.* Limnophyton obtusifolium, Miq. RAU, N. S.: *A Further Note on the Iron Hæmatoxylin Technique,* 67. VASUDEVA, R. SAHAI: *Effect of One Organism on the Parasitic Activity of Another.*

Industrial Outlook.

The Industrial Manufacture of Absolute Alcohol—II.

By Jean Caupin.

IN a previous article[1] an account was given of the azeotropic process employed for the dehydration of aqueous alcohol. This process, as employed for the first time in France in 1923, consisted in sending alcohol of about 95 per cent. strength obtained by the ordinary process into a second independent apparatus, wherein, by employing benzene as entraining liquid, absolute alcohol of 99·8—99·9 per cent. strength was obtained.

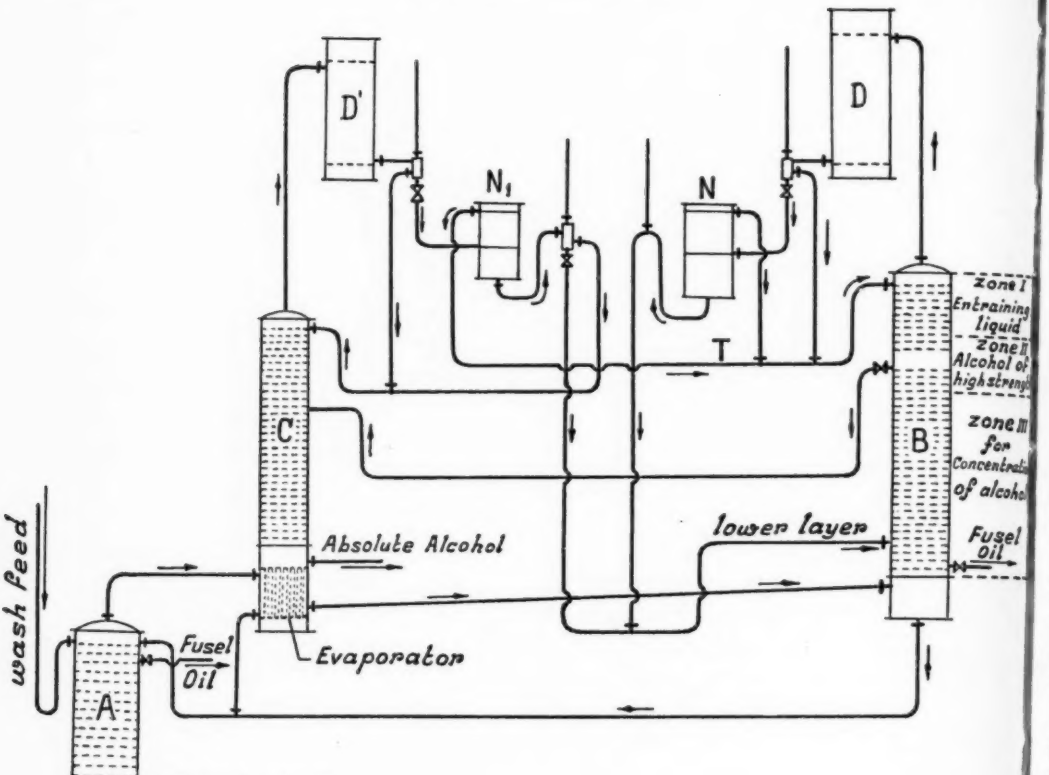
Recently, however, the researches of Guinot, the inventor, have rendered possible the manufacture of absolute alcohol from weak fermented liquors in a single operation instead of in two stages as was carried out in former years. At first sight, the above improvement appears to be impossible of attainment owing to the fact that, whereas in the ordinary process of rectification of alcohol, the concentrated alcohol is drawn off from the top of the column and water collects at the bottom, the reverse is true of the azeotropic process, *viz.*, the last traces of water present in the alcohol are carried to the top of the column and absolute alcohol collects at the base. This incompatibility is, nevertheless, easily resolved in practice, because the alcohol of high strength which collects in the upper plates of the concentrating column of the rectifier serves as an effective barrier owing to its ebullition point, which permits the addition of supplementary plates where the entraining liquid can work without difficulty for removing the last traces of water.

It will now be easy to examine and appreciate the scheme shown in the sketch of the equipment employed in industrial practice.

The fermented wash enters the column A and descends from plate to plate getting gradually exhausted at such a rate that the larger part of the water collects at the base. The alcoholic vapours heat up the column C and then undergo concentration in the column B. In the upper part of column B where the entraining liquid is introduced, the vapours present are similar in composition to that of the ternary mixture of water, alcohol and entraining liquid. The vapours are condensed in D and the liquid produced enters the decanter N where it separates into two layers. The upper layer which is a mixture of practically anhydrous alcohol and the entraining liquid returns continually to the top of the column.

Between the zone containing a high proportion of entraining liquid and the zone in which concentration of alcohol is effected,

[1] *Curr. Sci.*, 1935, **3**, 385.



there is found a range of 4–5 plates containing alcohol of high strength (98·5–99 per cent.) mixed with a little of the entraining liquid. A suitable quantity of mixture is sent into the column C which is heated at the surface, and in which by continuous distillation it is possible to drive out completely the small quantities of water and entraining liquid present.

The absolute alcohol is drawn off at the base of column C, which is kept heated by the vapours arriving from column A. The quantity of heat furnished during the exhaustion of the weak alcoholic liquors is found to be sufficient to effect the concentration. The remarkable advantages of the method outlined above consists in (1) absolute alcohol can be manufactured in a single unit and at the same price as rectified alcohol, and (2) dehydration is easily effected with 4 per cent. of head products as against 10 to 15 per cent. in the ordinary rectification.

Further, the recuperation by an easy method of the vapours of the entraining liquid and alcohol permits keeping the loss of benzene below 0·04 per cent. This last improvement is of great importance for the development of the process, because the most important outlet for absolute alcohol is in its use as motor fuel with admixture of petrol.

It is essential, however, that in case of war and menace of blockade, the industry will not come to a standstill, if the special entraining liquids cannot be imported.

It is easy to demonstrate that with a minimum stock of benzene, a country like India can produce considerable quantities of absolute alcohol by the azeotropic method.

The total consumption of petrol in India

in 1931 was 72 million gallons. Admixture of 20 per cent. of alcohol with petrol will permit of the utilisation of about 14 million gallons of alcohol which could be produced from 7 million maunds or 250,000 tons of molasses.

This production of alcohol can be assured with 30 factories, each producing 2,000 gallons per day. The quantity of entraining liquid required for the starting of all these 30 factories will be roughly 6,000 gallons. The loss of entraining liquid will not exceed one gallon per working day for each distillery and the annual loss during the production of the total requirements of alcohol will only be 6,000 gallons of entraining liquid.

This quantity is not sufficient for the establishment even of a small factory for the production of the entraining liquid in India because a small stock will satisfy the requirements of many years. The above explanation will, therefore, eliminate the adverse criticisms regarding the azeotropic method.

We give below the cost of production of rectified alcohol, absolute alcohol by the First Technique (transformation of 96 per cent. into 99·8 per cent.), and absolute alcohol by the Fourth Technique obtained directly from fermented wash.

Approximate cost of production per gallon of (1) *Rectified Spirit,* (2) *Absolute alcohol by the First Technique, and* (3) *Absolute alcohol by the Fourth Technique.*[2]

Basis of Calculation :—

We will take for our basis of calculation the following, which are actually those that prevail in India :

Crushing capacity of the Sugar Factory : 400 to 600 tons.

Capacity of the Distillery : 750 maunds of molasses, *i.e.*, about 1,500 gallons (minimum) of alcohol every 24 hours, 200 working days, making an annual production of 300,000 gallons.

Price of molasses Re. 0–4–0 per Bengal maund.

Fuel : wood at Rs. 7 a ton.

1 lb. of wood gives 2 lbs. 8 oz. of steam, *i.e.*, price per lb. of steam is Re. 0–0–0·24.

We shall assume that the steam will be supplied by the boilers and the water by the pumps of the Sugar Factory.

(1) *Cost of obtaining a gallon of Rectified Spirit* :—

		Rs.	A.	P.
1.	Building and Plant : about Rs. 187,500, to be redeemed in 10 years, *i.e.*, per gallon..	0	1	0
2.	A maund of molasses ought to give two gallons of alcohol..	0	2	0
3.	Consumption of steam ; starting from fermented wash to obtain rectified alcohol : 38 lbs. at Re. 0–0–0.24 per lb., *i.e.*,..	0	0	9.12
4.	Chemical products	0	0	0.73
5.	Labour and staff : 9 men and 3 Indian chemists	0	0	3
6.	Overhead expenses (Insurance, fire, interests, upkeep, office expenses)	0	0	4
	Total expenses per gallon of rectified alcohol	0	4	4.85

The cost per gallon is about four annas six pies.

(2) *Cost of obtaining a gallon of Absolute Alcohol by the First Technique* :—

1.	Cost of rectified alcohol ..	0	4	6
2.	Consumption of steam, starting from rectified alcohol to obtain absolute alcohol : 13 lbs. of steam at Re. 0–0–0.24 per lb.	0	0	3.12
3.	Loss of alcohol, *i.e.*, the difference between the quantity of alcohol that enters and that which comes out of the dehydration apparatus : 0.15 per cent. at Re. 0–4–6 a gallon	0	0	0.08
4.	Loss of carrying liquid (Benzol) : 0.04 per cent. at Rs. 3–7–0 per gallon	0	0	0.28
5.	Plant : about Rs. 50,000 to be redeemed in ten years ..	0	0	3.20
6.	Staff : 2 men	0	0	0.20
7.	Royalties, about	0	0	5.50
	Total price per gal.	0	5	6.38

The cost per gallon is about five annas six pies.

(3) *Cost of obtaining a gallon of Absolute Alcohol by the Fourth Technique* :—

Same consumption of steam as for rectified alcohol.

No loss of alcohol.

Same staff.

As a result of which the cost price is the same as that for rectified alcohol.

Four annas six pies.

Remarks :—

From the commercial point of view, the costs given above are perhaps excessive, because they are based on consumption of expensive fuel and also that all the molasses produced in a sugar factory can be sold at four annas per maund.

[2] The writer has, from actual experience in India, confirmed these figures.

In a succeeding article, it is proposed to discuss the very important question of alcohol as a fuel for power-raising purposes, and also to indicate the possibilities shown by the starting of the Distillery of the Mysore Sugar Factory, Mandya, the entire plant for which was furnished by *Ateliers Pingris et Mollet-Fontaine Reunis, Lille, France.*

Reviews.

HAND- UND JAHRBUCH DER CHEMISCHEN PHYSIK. Edited by A. Eucken and K. L. Wolf. Volume 9, Part 2. (Molekul- und Kristallgitterspektren. Akademische Verlagsgesselschaft M.B.H., Leipzig, 1934.)

This volume contains authoritative articles by Reinkober, Teller, Mecke and Finklenburg on the experimental methods of infra-red spectroscopy, the theory of molecular and lattice spectra in the long wave region, the band spectra of diatomic molecules and finally the structure of some special molecules based on their spectra. In the article on the infra-red spectroscopy, Reinkober has given an account of the various sources of radiation, the different instruments for receiving the radiation, the experimental methods of the analysis of the radiation and the determination of wave-lengths in it. This account of the experimental methods seems to be fairly comprehensive. The theory of molecular spectra in the long wave region has been dealt with by Teller in a very clear fashion. He has presented the theory of the vibration, the rotation and their interaction in the case of a diatomic molecule both on the classical and quantum-mechanical standpoints and also their activity in the infra-red and Raman spectra. Next, the normal vibrations of a polyatomic molecule, their symmetry properties and the selection rules governing their activity in the infra-red and Raman spectra have been dealt with. The rotation of a polyatomic molecule, the interaction of rotation and vibration and the isotope effect in vibration have been also treated. In the next article on the lattice spectra, he deals with the total reflection in the vicinity of a region of absorption and the vibrations of a linear lattice. He has pointed out the relations that exist between the spectra and other properties of crystals. The article on band spectra by Finklenburg and Mecke contains the methods of the photography and the analysis of band spectra, the application of wave-mechanics to a model with two centres, the treatment of the nuclear motion and rotation and the interaction of the rotation and electron motion in the model. The symmetry properties of molecules and their band structures have also been dealt with. The experimental results of band spectra of diatomic molecules have been collected and presented by Mecke in the next article. The chapter on the structure of polyatomic molecules on the basis of their spectra has been written by Mecke. The expressions for the frequencies of the XY_4 type given on page 353 requires modifications. In the case of acetylene, there seems to be no clear reason as to why $\delta\,(s)$ (inactive) should be 600 cm.$^{-1}$ except that it should interpret the 1329 cm.$^{-1}$ band in combination with $\delta\,(a)$ which is 729 cm.$^{-1}$ One may note that the band in question can be interpreted as $\nu_1\,(a)-\nu_0\,(s)$, and the 5250 cm.$^{-1}$ band as $\nu_1\,(a)+\nu_0\,(s)$, which is in conformity with Dennison's selection rules. A theoretical calculation of the frequencies based on the valence force system shows that $\delta\,(s) > \delta\,(a)$, thus throwing doubt on the assumption that $\delta\,(s)$ is 600 cm.$^{-1}$ The split of $\nu\,(a)$ in CBr_4 observed by Langseth may be explained as due to the resonance $\nu(a) \sim 2\nu(s)+\delta(s)$.

The volume contains clear articles by authoritative persons in the subjects dealt with.

N. S. N.

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PHOTO-ELECTRIC AND SELENIUM CELLS, THEIR OPERATION, CONSTRUCTION AND USES. By T. J. Fielding. (Chapman & Hall Ltd., London.) Pp. 140. Price 6*s*.

Next to the thermionic valve the photo-electric cell can claim to be one of the most outstanding inventions of the present century and has as universal an application as the former. The advent of the talking pictures and the more recent developments in television has created in the general public a keen desire for knowledge of this interesting device. The host of books that have appeared from time to time have failed to meet this demand since they are very often either too technical or at least demand a fairly good scientific background.

This little book although very limited in its purpose does justice to the intentions of its author, namely providing a brief

introduction to the use of light-sensitive devices in general. The author gives a lucid description of photo-electric and selenium cells and their construction, providing an average practical-minded person, data enough to construct some of the simpler type of selenium cells. The chapter dealing with talking pictures, television and its application to general industry will familiarise the reader with the principles and uses of the photo-cell. On the whole a very useful book for a beginner.

C. C.

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A SYMPOSIUM ON ILLUMINATION. By C. J. Webber Grieveson. (Chapman & Hall Ltd., London.) Pp. 229. Price 13*s.* 6*d.*

The book is a collection of lectures, each probably lasting for an hour or so, delivered by eminent men counted as authorities in the various branches of Illumination, as acknowledged by the Editor himself in his Note. It is certainly the best collection I have known. All that could be squeezed within the limited space allotted to the authors has been presented and made intelligible. The book can be recommended to every one who wishes to have a general idea of illumination for various purposes, which no engineer can afford to overlook in the modern rush for securing the best illumination with minimum expenditure.

M. HAYATH.

* * *

SHORT COURSES IN CHEMICAL THEORY. By E. P. Wilson. (T. M. Dent & Sons, Ltd., London, 1935.) Pp. viii+247. Price 3*s.*

There are very few publications which can be grouped along with the book under review in view of its somewhat novel treatment. The book is a collection of lecture-notes on chemical theory, highly useful to teachers and students alike. There are 22 chapters, dealing with the various aspects of chemical theory as taught in the Colleges to senior students. The notes serve to concentrate the attention on the crucial points of the subject. The book is a very useful addition to every College Library and is the outcome of the long experience of a *teacher*. Provision is made for the addition of examples, notes and diagrams in the book by the insertion of blank pages and the student is thus enabled to add to the information already contained in the book.

The Book is not, however, free from errors and from the point of view of the student this is to be regretted. To cite a few random instances: on page 87 under enzyme actions *emulsin* is printed as *emulsion*; one does not speak of *badly* ionised solutions (pages 143 and 144) but of *weakly* ionised solutions; sentences which have no relation to the context are often used as for instance, on page 171, under Osmotic pressure of colloids, it is difficult to understand the bearing of the sentence *Parchment paper* (*a colloid*) *gives best results*; on page 172 under electrical properties (5) the sign, =, used against KCl, $MgCl_2$ and $AlCl_3$ is incorrect, as the author intends to convey that 49·5 parts of KCl, 0·717 parts of $MgCl_2$ and 0·093 parts of $AlCl_3$ possess equal capacities for bringing about coagulation; on page 216, in providing examples for ionic dissociation in solutions we find that the dissociation of NaCl is represented as $NaCl \rightarrow Na + Cl'$, it should read $NaCl \rightarrow Na^{\cdot} + Cl'$. We should also like to see a glossary attached as it is somewhat difficult to understand the large number of abbreviations so often used throughout the text. In spite of these obvious errors, the book should prove highly useful to college students preparing for examinations.

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STUDIES ON INDIAN ITONIDIDÆ (*Cecidomyidæ diptera*). By M. S. Mani. (Records of the Indian Museum, Calcutta, 1934.) Vol. 36, Part IV. Pp. 371–451. (28 Figures and 1 Plate.)

The study of galls interests the zoologist, as most of them are caused by the agency of insects and mites; the botanist, since the host plants often show a specific behaviour towards the causal agencies; and lastly, the plant pathologist, whose labours contribute towards a comparative pathology of tumours and cancers. In Germany, Hedicke, the Berlin Zoologist, Ross, the Munich Botanist, and Küster, the Plant-Pathologist at Giessen, have each shown how galls are worthy of attention. India, with its abundant supply of material for study, offers a virgin ground for the study of galls from all these three standpoints. Mani's monographic study of *cecidomyid* gall producers may be taken as a precursor of many more communications in this field. His study, under review, is not "Notes" or a sketchy study of the material he already found in the Calcutta Museum; he has personally collected most of the specimens described, even adding notes on the life-histories of the insects wherever opportunities permitted him to gather such information. This partly explains why most

of the insects named are derived from South India. We hope, inspired by Mani's example, others would also extend our knowledge of Indian gall-producing insects. Most Indian entomologists have confined their enthusiasm to the field for, when the question of naming new species had to be faced, they preferred acting as exporters for specialists outside to sift through the mass of crude material and thus enjoy the prerogative of creating names new to science giving their own study the stamp of a finished article. Mani has taken on himself such a responsibility and has given to the world several new genera, not to say of new species. A complete bibliography is given and grateful acknowledgment is made to several authorities. While his claim to originality is self-evident, it is equally apparent that a vein of modesty impregnates his style which makes his publication the more agreeable reading. The monograph ends with a single plate, containing photographic reproduction of five kinds of galls whose causal agents have been named by Mani; we only wish there were more of them. His pen and ink illustrations might have been better, particularly Fig. 19 on page 426, hardly does credit to the otherwise excellent study of Indian *Cecidomyids*. S. M.

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A REPORT ON THE PROSPECTS OF PAPER MANUFACTURE IN HYDERABAD STATE. By Md. Moula Baksh, M.A. (Oxon.), F.L.S., and Khaja Nazamuddin, B.Sc., Tech. A.M.C.T. (Manch.) Pp. 71. (H. E. H. the Nizam's Government: Commerce and Industries Department Bulletin No. 4, New Series.) Price Rs. 2-8-0.

This report discusses the advisability and practical possibilities of establishing a pulp and paper mill in the Adilabad District making use of bamboo (*Dendrocalamus strictus*) available in the area as the source of fibre. It has been shown that good paper can be manufactured from these bamboos as is evident from the samples contained in the report.

The total production of paper in India at present is only 45,000 tons a year, while the import for the same period averages about 100,000 tons. All the relevant facts including cost of the raw materials have been discussed in detail in the report with a view to encourage some capitalist to start a factory and we hope that the expectations of H.E.H.'s Government will be realised in the near future. K. A. N. R.

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Creatine et Creatinine par Fernand Kayser (Actualites Scientifiques et Industrielles No. 178. Hermann et Cie, Paris).—This little volume is divided into two parts. Part I is devoted to a description of the chemistry of creatinic substances and Part II to the biophysical studies. A clear and critical review of the existing methods of preparation and estimation, including some of the author's investigations, is given. There is an excellent bibliography in the end. The author complains of the insufficiency of the work done on these substances in France. C. S.

* * *

Metabolismes Des Corps Creatiniques par Fernand Kayser (Actualites Scientifiques et Industrielles No. 179. Hermann et Cie, Paris).—As in the previous number, this book also contains two parts. Part I treats of the metabolism of creatin and creatinin discussing in some detail the occurrence of creatin and creatinin in urine under physiological, pathological and experimental conditions. Part II deals with the pathological conditions only: the variation of creatin and creatinin in the affectations of the kidneys, muscles, the thyroid gland and in certain diseases like diabetes, gout, arthrites, etc. The prognostic value of determining these creatinic substances in the body fluids is indicated. Only eight pages are devoted for the pathological study, perhaps to keep in conformity with the shortness of these monographs. A good bibliography is appended. C. S.

Forthcoming Events.

The Geological, Mining and Metallurgical Society of India:—
Annual General Meeting, Monday, 2nd September 1935, 5-30 p.m.

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